MACHINE DESIGN

PARTS • MATERIALS • METHODS • FINISHES

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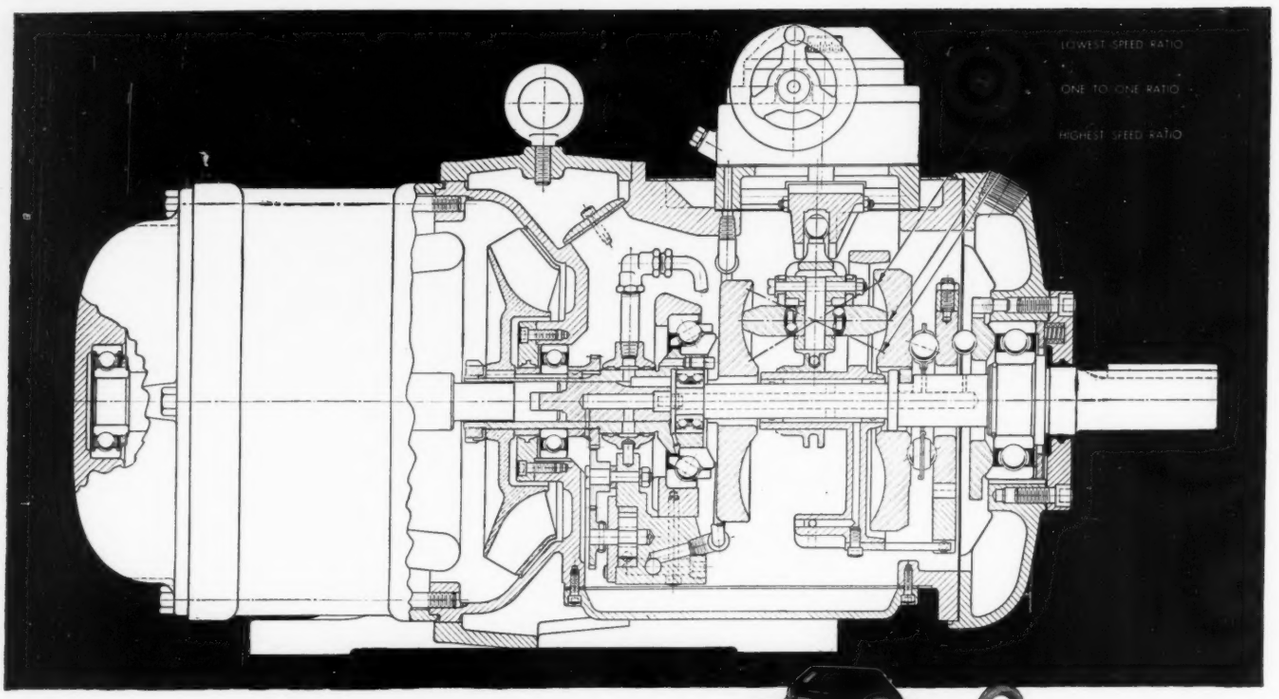

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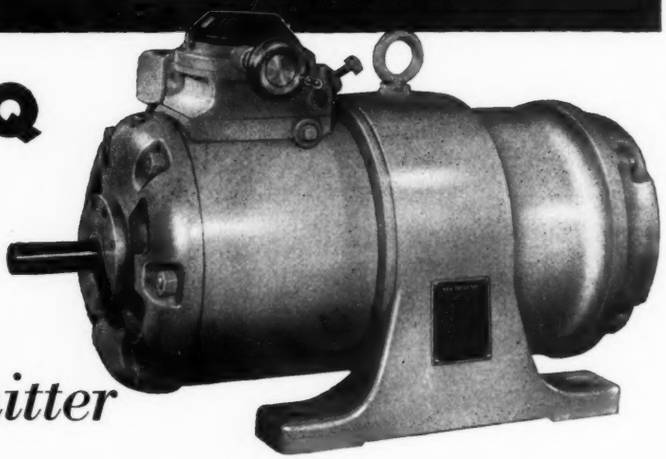

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Itemized Index

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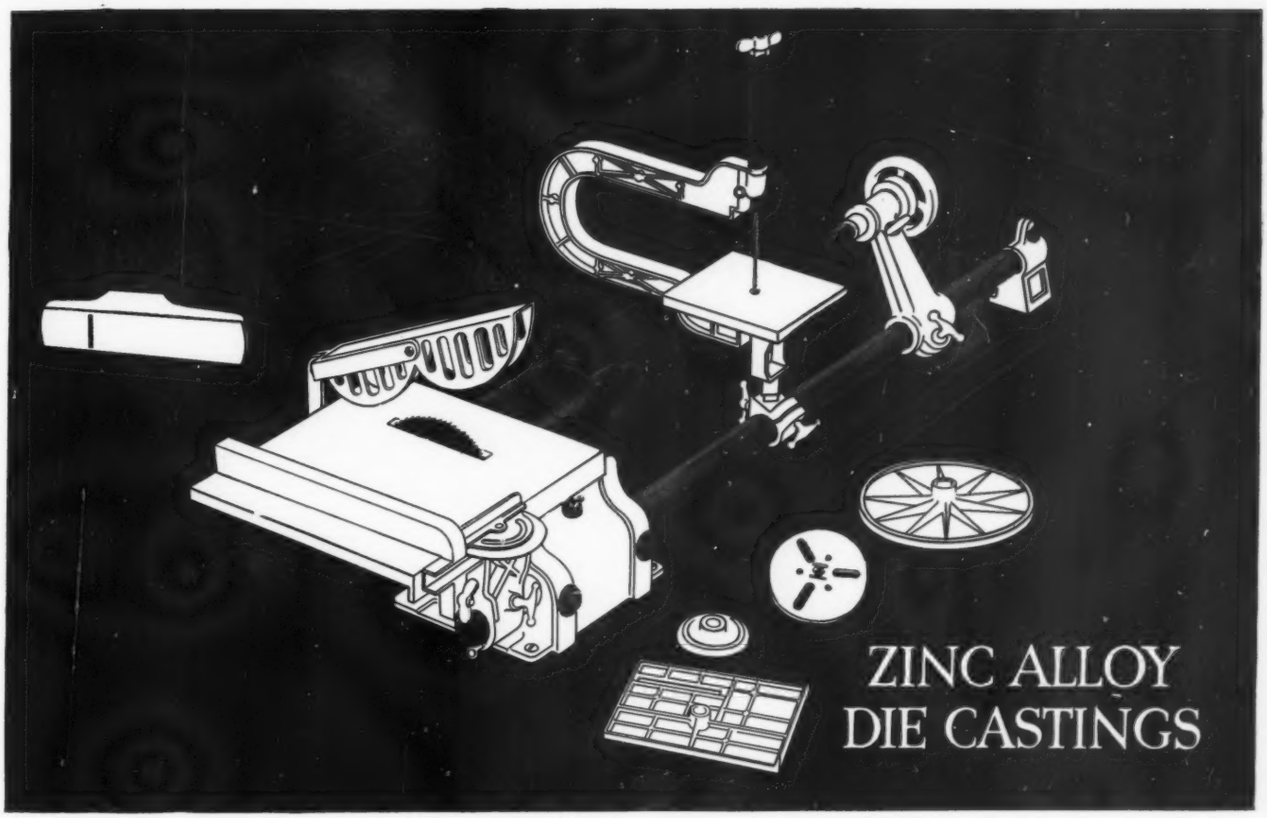
Key: Edit., Editorial Pages; Adv., Advertising Pages; R, Right hand column; L. Left hand column



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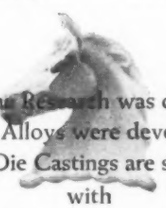

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Calendar of MEETINGS and EXPOSITIONS

MACHINES and materials, inseparably joined in the minds of designers, are principal meeting topics in September. . . . The Machine Tool Congress opens in Cleveland on the 11th. . . . The National Metal Congress will hold its sessions in Chicago starting on the 30th * * * In Cleveland's Public Auditorium will be held the National Machine Tool Exposition. . . . This mammoth show will include design ideas which have been incubating for years. . . . Designers will be able to obtain a preview of future developments * * * At the Machine Tool Congress A. H. d'Arcambal will speak on standardization of machine and tool data. . . . Rustproofing and paint adherence technique is the subject of F. P. Spruance. . . . An important subject, the relation between manufacturing and engineering, will be discussed by D. G. Roos.

Latest developments in metallurgy and welding will be presented at the National Metal Congress. . . . Arc welding of high carbon and alloy steels will be discussed by T. N. Armstrong. . . . A new heat resistant alloy will be presented by S. L. Hoyt and M. A. Scheil. . . . A. E. White, C. L. Clark and R. L. Wilson are to talk on the influence of carbon content on the high temperature properties of steel. . . . Chromium steels of high nitrogen content is the subject of Russell Franks. . . . H. M. Wilton will have as his topic the correlation of failures from embrittlement of 4 to 6 per cent chromium steel with the notched bar impact test * * * Other discussions will cover the aging of steel, endurance of casehardened gears, and damping capacity as a factor in fatigue.

Sept. 11-21—

National Machine Tool Exposition. Third exhibition of machines, parts and materials to be held in Public Auditorium, Cleveland, under the auspices of National Machine Tool Builders' association. Roberts Everett Associates, 232 Madison Avenue, New York, are managers of the exposition.

Sept. 11-21—

National Machine Tool Congress. Third congress to be held in Cleveland under the auspices of the Machine Tool Builders' association; Machine Shop Practice division, American Society of Mechanical Engineers; and Production Activity division, Society of Automotive Engineers. Herman H. Lind, 1220 Guarantee-Title building, Cleveland, is general manager of the Machine Tool Builders' association.

Sept. 18-28—

National Electrical and Radio exposition. To be held at Grand Central Palace, New York. Information on the exposition may be obtained from Ralph Neumuller, managing director, Grand Central Palace, New York.

Sept. 24-26—

Association of Iron and Steel Electrical Engineers. Annual convention and exposition to be held at William Penn hotel, Pittsburgh. T. B. Little, Empire building, Pittsburgh, is acting managing director of the association.

Sept. 30-Oct. 4—

American Welding society. Annual fall meeting to be held at Chicago. M. M. Kelly, 33 Thirty-ninth street, New York, is secretary of the society.

Sept. 30-Oct. 4—

American Society for Metals. Seventeenth annual National Metal Congress to be held at the Palmer House, Chicago. W. H. Eisenman, 7016 Euclid avenue, Cleveland, is secretary of the society.

Sept. 30-Oct. 4—

National Metal exposition. Seventeenth annual exhibition to be held in International Amphitheater, Chicago. W. H. Eisenman, 7016 Euclid avenue, Cleveland, is general manager of the exposition.

Sept. 30-Oct. 4—

American Institute of Mining and Metallurgical Engineers. Fall meetings of Iron and Steel and Institute of Metals divisions to be held in Chicago. John T. Breunich, 29 West Thirty-ninth street, New York, is assistant secretary of the institute.

Oct. 14-15—

American Gear Manufacturers' association. Eighteenth semiannual meeting will be held at The General Brock hotel, Niagara Falls, Canada. J. M. McQuiston, Penn Lincoln hotel, Wilkinsburg, Pa., is manager-secretary.

Oct. 14-19—

National Business Show. Exhibition of machines and equipment to be held at Commerce Hall, Port Authority building, New York. Frank E. Tupper, 50 Church street, New York, is secretary of the exposition.

MACHINE DESIGN

Interchangeable Units Key to Flexibility

By Alex Oberhoffken

Development and Research Engineer, Ingersoll Milling Machine Co.

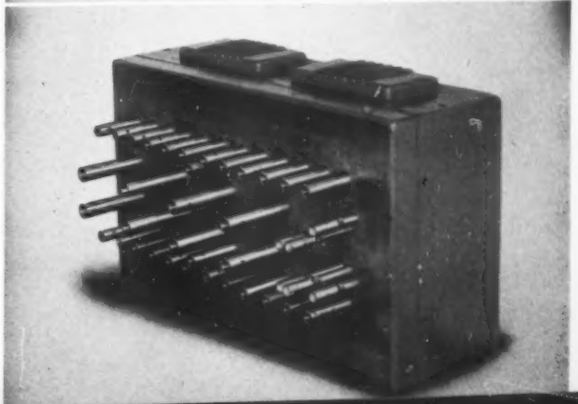
IT IS difficult to realize that every mechanism of fast-moving, intricate machinery can be reduced to the six basic mechanical principles. Men who are now only names remote in history gave us the lever, the inclined plane and the pulley, and, from these, the wheel and axle, the wedge and the screw. Every motion used today can be traced to these forebears; for example, gears hark back to the lever, cams to the inclined plane. It is the combination of these principles and their careful co-ordination that marks the successful machine.

Similarly, every machine tool can be reduced to fundamental parts which go to make up the whole. There is, in each case; a source of power; tools; means for moving the tool or the work, as the case may be; a method of holding the work; and supports for locating both the tools and the work in proper relation. It may seem that no two types of machine tools are at all similar, but the fact remains that basically they all have similar parts, the function of which is to perform tasks of an identical nature.

Recalling these basic facts, The Ingersoll Milling Machine Co. determined to build a machine which would, with simple adjustment, be able to perform either continuously or in rotation any of the tasks usually assigned to a series of machines — a machine which could be taken apart and entirely rearranged to accommodate the fast moving changes in parts being processed. This aim required the co-ordination of the elements of in-

Fig. 1—Self-contained driving and feeding unit provides power for all operations

Fig. 2—Tools are carried by work units which vary according to class of work



dividual drilling, boring tapping and milling machines into a single complete machine. Also, it was necessary that each element retain its identity after it became a part of a complete machine so that it might later be used to serve a similar purpose in another combination.

Reduced to Eight Units

In the design it was decided to reduce the machine to eight basic units. These are: Fixture pedestal which raises the work to convenient height; bed wing to raise working portions of the machine to height of the work; vertical housing for use when approach is desired from above; slide which provides the means of approaching and retreating from the work; saddle which carries the moving parts; fixture for holding work; work unit to carry the tools; and the power embodied in a unit known as the Power Pack which is a complete self-contained driving and feeding unit that provides the power for all movements.

This simplification of the machine permits the complete isolation of the design of one part except at the surfaces where that part meets one of the others, and enables the design to be carried out in unit steps. Fixture pedestals, *Fig.* 7 are standard for all work. Fixtures, *Fig.* 8, vary, of course, to accommodate the part being processed. Bed wings, *Fig.* 4, are standard for any combination of elements. Screw holes on the upper surfaces of the bed wings match the screw holes in the slides and also the screw holes in the base of the vertical housing which can be seen at *A* in *Fig.* 6. Thus the slide and the vertical housing are interchangeable on the bed wing. Also, the screw holes on the slides exactly match those on the face of the vertical housing, permitting unification by enabling the slides to be attached to the vertical housing without change. Saddles, *Fig.* 5, are again standard for any size of power pack and for any work unit, while slides, *Fig.* 3, vary only as to length.

The work units, *Fig.* 2, naturally vary according to the type of work to be done, with a further variance to fit the varying sizes of power packs. A work unit designed for a 15 horsepower pack cannot be inadvertently connected to a 5 horsepower unit. Standardization in the power packs finishes at the point where they are all designed to fit upon the same saddle as there is a range of sizes available.

Fig. 6—*(Right)—Complete machines are so designed that the units may be taken apart and reassembled in a variety of combinations, as shown. Each unit can be used without change in the new assembly*

Raiser and wedge blocks are available for use in elevating the vertical housing or the slide, or arranging the approach of the tool at an angle to the work as shown in *D*, *Fig.* 6.

For other variations, starting with a simple machine consisting of a bed wing, fixture pedestal and fixture, slide, saddle, power pack and work units, the angle of approach can be changed by adding a wedge block to give an angular approach, a raiser block to give higher approach or a vertical housing to give a vertical approach rather than horizontal. The original parts are all used in the new assembly.

Approaching the design flexibility in another way, let us suppose that the operation for which

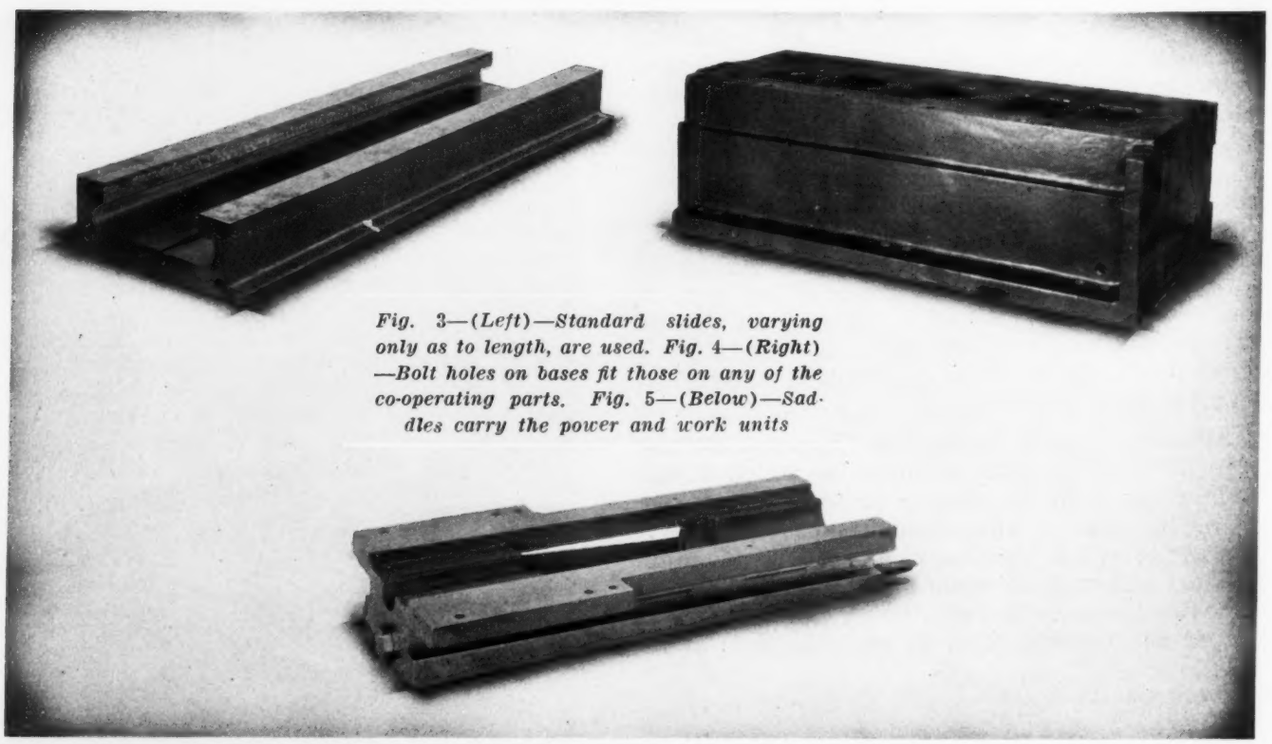
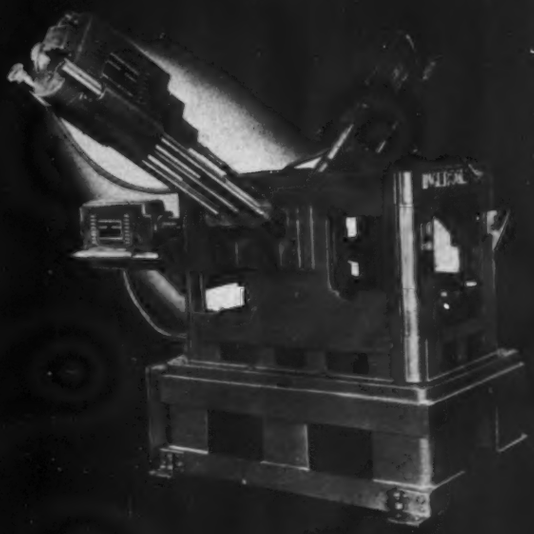


Fig. 3—*(Left)—Standard slides, varying only as to length, are used. Fig.* 4—*(Right)—Bolt holes on bases fit those on any of the co-operating parts. Fig.* 5—*(Below)—Saddles carry the power and work units*

Identical Units— Different Machines

A



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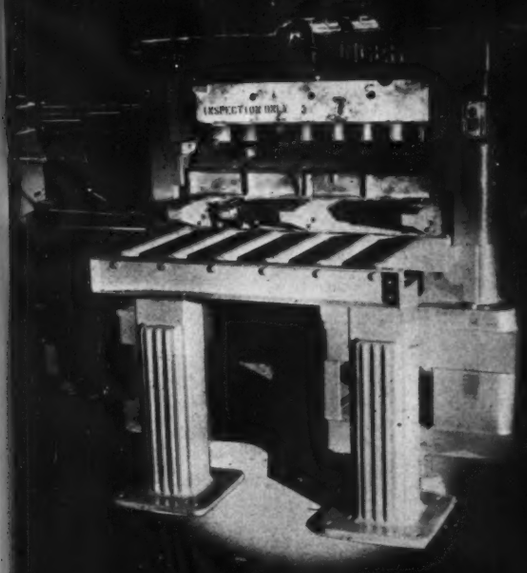

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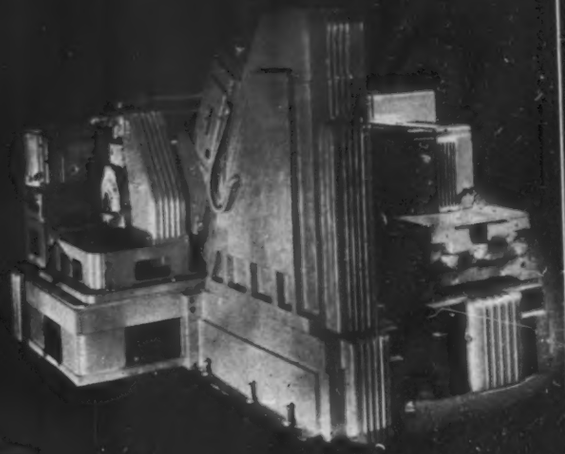
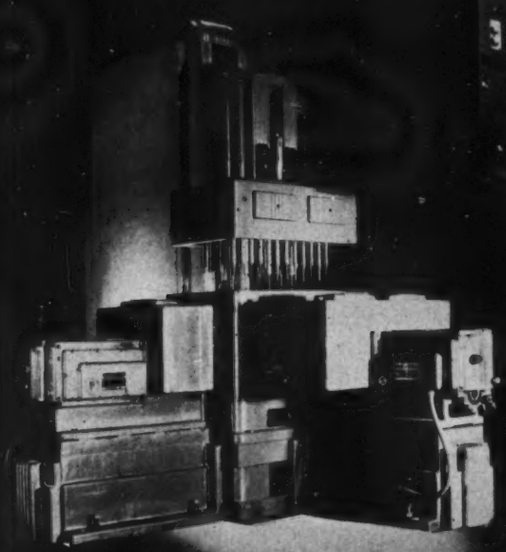
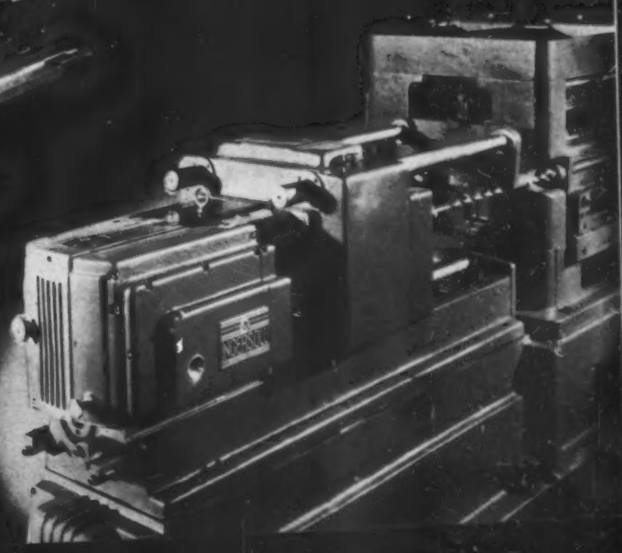


D

E



F



G

the machine shown at *F* in *Fig.* 6 was assembled, no longer was necessary. It would be possible to separate the two wings and have two horizontal and one vertical machine by the addition of two fixture pedestals and two fixtures. The combinations are, as can be seen, endless.

However, even though there are many combinations, there are some parts that require processing which cannot be treated in any of the standard units. In these cases the packs may be mounted on bars instead of slides, as at *B*, *Fig.* 6 (this is done only with the smaller sizes of packs) or the pack may be stationary while the work moves as at *E*.

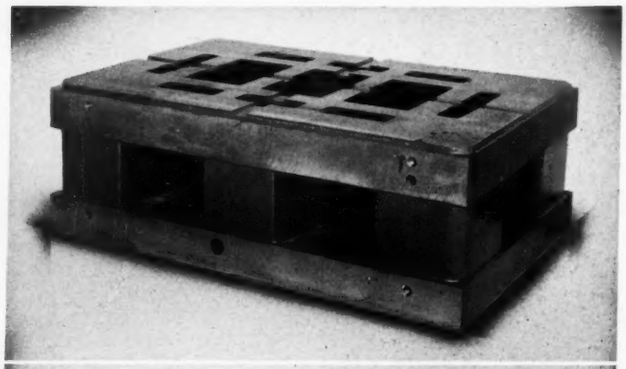


Fig. 7—Standard fixture bases can be employed for any operation required in the different assemblies

Each pack contains a driving motor and a rapid traverse motor, connected through differential gearing to the power take-off for the work unit. The driving motor travels continuously in one direction while the rapid traverse motor is reversible. Both motors are of the shell type, dynamically balanced and fan cooled. A sufficient quantity of air is assured by louvres in the sides of the packs. By the use of one motor to both drive the tool and rotate it, a completely synchronized action is obtained at all times regardless of the structure of the material being processed or the type of work being done. The forward and reversing drive is through a nut on the pack which co-operates with a screw on the slide. All gearing and the shafts are of chrome-molybdenum steel, selected to permit high strength with small sizes.

Power is transmitted to the work unit by a semi-flexible coupling. Inside of this work unit the power is distributed to the various tools through gearing. The speed of the take-off shaft was selected as that which would be the highest desirable, 960 RPM. If a lower speed is desired, the reduction is accomplished by the gearing inside of the work unit.

Complete control of the pack is given to electrical units which can be so arranged that a widely varying series of operations take place. The desired sequence is established on key-type controllers which have eight cycle keys rotated in steps with control dogs.

Inasmuch as the outstanding appearance of this machine has excited comment, it might be believed that appearance was one of the first and foremost design problems to be considered. This was not the case. In the design of all parts the functional duty of the part was first adequately covered, then the part was considered from the standpoint of appearance and its exterior portions were designed to harmonize with the appearance of other units on the machine.

The decorative lines on the parts are employed to emphasize the function of each part. When the part moves, the lines run parallel to the direction of motion. Finish for the parts is a standard machine tool gray, but the possible plainness of such a surface, overcome to a degree by the shape of the parts, is further avoided by the use of nameplates in several bright colors. The use of such nameplates not only adds to the appearance by providing bright spots which harmonize with the whole, but they also give additional attention value to the name of the manufacturer.

Further consideration of appearance was given to the design of conveyor pedestals, *B* in *Fig.* 6, where again the lines are planned to harmonize. Also, socket head screws used throughout aid in establishing clean lines. However, the use of these screws was not dictated from the appearance angle alone. Their compactness permits a more easily cleaned machine, and one more easily cleaned will be kept cleaner.

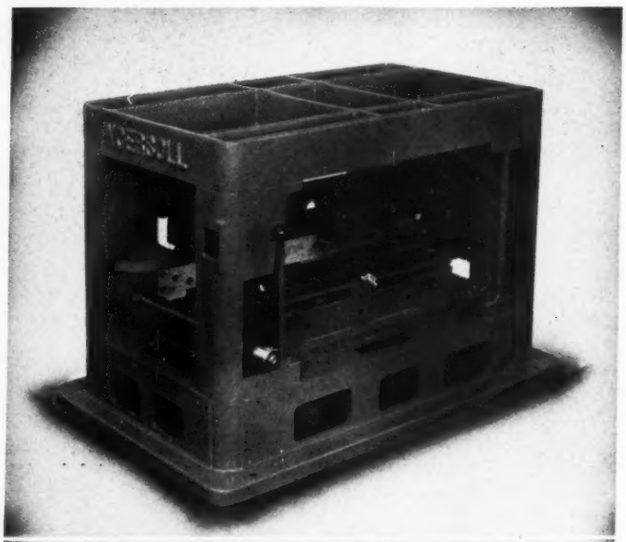


Fig. 8—Varying work fixtures are employed to satisfy the different types of pieces which are being processed

Scanning the Field . . . FOR IDEAS

ALL aggressive manufacturers are insisting that at least some of their designers visit the machine tool exposition. Their motive goes beyond the production facilities featured in this tremendous exhibit of equipment—they see in the array of recent developments a store of new ideas that may be utilized. These cohorts of designers in examining the machines at the show will carry away many impressions that will be evolved into improvements in their own specific, though probably not competitive, creations. In other words, the transference of ideas from field to field will be eminently apparent months after the exposition is over.

LATHE MAKES OWN CALCULATIONS

DESIGNERS referred to in the foregoing will be attracted for example by the new lathes, virtually all of which embody the latest trends. In them will be found many an unusual innovation applicable to other machines. It may be an automatic slide rule, *Fig.* 1, which gives spindle speeds and cutting speeds in feet per minute, this particular idea being a feature of the Lehmann Hydratrol. Speed changes in this are effected by turning a three-lever handle on the front of the headstock. Co-ordinated with the movement of the handle is the slide rule. The selector valve shaft has an index mechanism to register it in the sixteen different positions for the sixteen speeds. The shaft carries a gear through which an intermediate gear meshes with a rack on the sliding member of the slide rule.

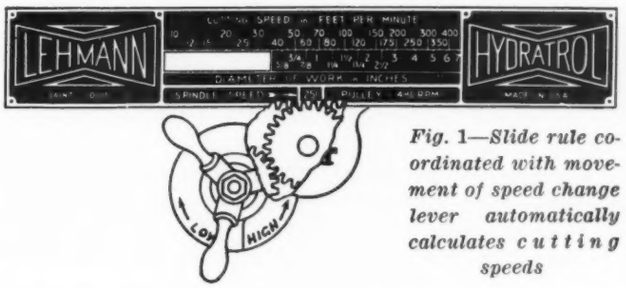


Fig. 1—Slide rule coordinated with movement of speed change lever automatically calculates cutting speeds

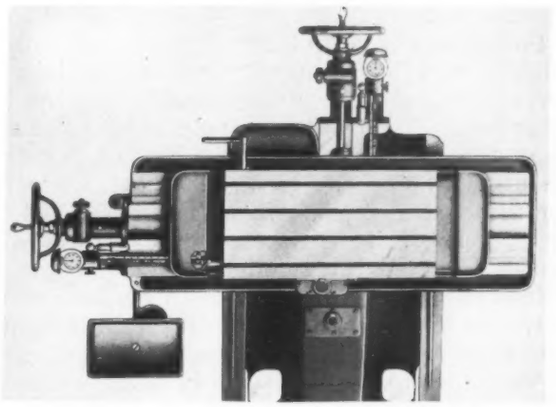


Fig. 2—Built-in lighting on this jig borer obviates eye strain and insures accurate reading of indicators

Diameters of work within the range of the lathe are given on the sliding member and register with the effective cutting speed on the stationary scale. Calculation by the operator is unnecessary. The speed changing handle is moved until the diameter of the work registers with the specified cutting speed in feet per minute, and the lathe automatically makes the necessary changes for predetermined requirements.

BUILD LIGHTS INTO MACHINES!

BUILT-IN lighting is a trend in the design of machinery that is growing by leaps and bounds. No engineer can ignore its possibilities, particularly when he incorporates devices that demand close scrutiny by the operator to maintain precision. A case in point is the new Pratt & Whitney jig borer, *Fig.* 2. It will be observed

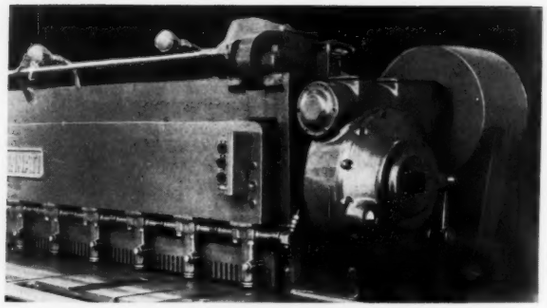


Fig. 3—In addition to convenience, built-in lighting provides light beam that serves as marker for shearing

that over each of the two measuring devices depicted, electric light fixtures with reflectors are positioned to illuminate the dials of the respective indicators. Not only machine tools wherein accuracy is a paramount factor but in many other types of machines, is this idea extremely practicable.

Sometimes a development such as built-in lighting can be utilized to advantage in more ways than purely as a means for improving illumination. For instance, Cincinnati Shaper company found that the built-in electric lights on its all-steel shear, *Fig.* 3, could be focused to facilitate shearing accurately to a scribed line on the sheet. It is necessary only for the operator to place this predetermined line on the bright edge of the light beam to insure a square cut, thus avoiding the usual difficulty of sighting the position of the sheet from the end of the shear or from the top of the table.

SIMPLE BUT EFFECTIVE LUBRICATION

LUBRICATION of the arbor support of the new Sidney Maximiller is obtained effectively by a simple device, which proves again that an idea to be valuable need not embody elaborate and complicated mechanisms. This heat treated aluminum alloy self-oiling milling machine member, *Fig.* 4, is designed with an oil reservoir *A* from which lubricant flows by gravity to the plugged hole *B*. At this point in the arbor a flush oiler is employed. Ball *C* of the small unit is forced down when the arbor sleeve is inserted by an operator in the bushing, thus allowing the entrance of oil to furnish adequate lubrication for this section of the machine.

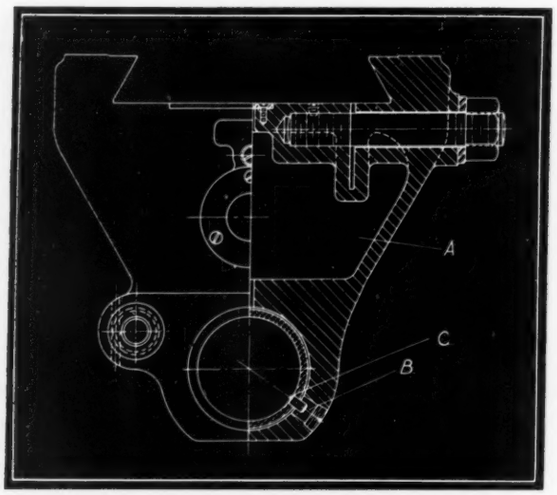


Fig. 4—Milling machine arbor embodies a flush oiler which supplies lubrication automatically in operation

PLASTICS SET ANOTHER RECORD

PLASTICS have scored another success that opens still broader fields of application. Size might at one time have been a limiting factor, but with the advent of the Plaskon case for the new Toledo duplex scale this problem ceases to cause concern among designers. The molding, *Fig.* 5, used as the housing for a radically new type of weighing unit, measures 17¾ by 14⅝ by 11⅛ inches, the largest practical plastic part on record. Particularly significant is the fact that the technique employed in molding a part of its unprecedented size is applicable to many other machines and devices. To accomplish the molding feat General Electric installed a giant new press.

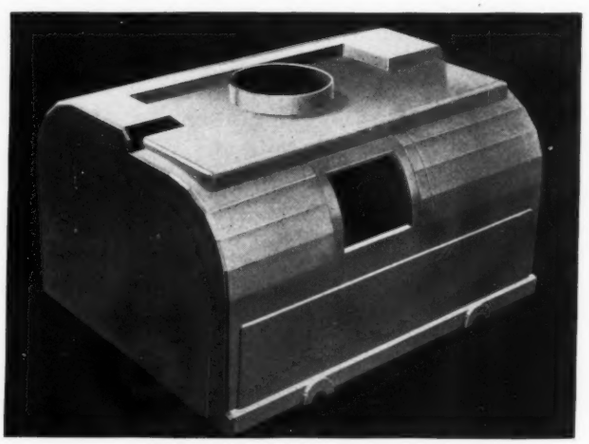


Fig. 5—The successful molding of this large scale case opens new fields for plastics in design

Plaskon, the material employed, is a urea formaldehyde plastic, and is unusually light and durable. Total weight of the scale is but 55½ pounds of which only 8½ pounds are vested in the case as compared to the 50 to 75-pound cast metal housing used on preceding models. Besides contributing largely to the reduction of weight, the use of the plastic molding provides a gleaming white exterior surface, thereby eliminating finishing problems.

Another modern material to be incorporated in the scale is aluminum. The fourteen parts of

this metal employed weigh 18 pounds. One of the most interesting members is the cylindrical weight chart, constructed of a thin aluminum sheet and containing more than 95,000 figures. By the employment of special lenses it was found possible to double the numeral capacity without reducing the legibility of the digits and intervals. Use of aluminum for the cylinder does away with flywheel effect and obviates possibility of distortion. Van Doren & Rideout, eminent industrial designers, are responsible for the attractiveness of the machine.

BALANCING MACHINE IS REFINED

MANY of the objections associated with mechanical devices have been eliminated in the new Westinghouse electronic dynamic balancing machine, *Fig.* 6. With the aid of a stroboscopic tube the point of unbalance is visible during operation regardless of speed, and the amount of unbalance is read directly on a calibrated meter. Applications have included small rotors from 1¼ to 3 inches in diameter, medium size rotors up to 100 pounds, and large rotors such as turbogenerator members weighing as much as 125 tons.

Complete unbalance determination can be had without calculation with a rotor running in its own bearings, and unbalance may be determined at high speeds of rotation (over 10,000 revolutions per minute), making it possible to balance a high speed rotor for distortion due to rotation. In previous machines a mechanical element was required to separate the two unbalanced effects as well as to support and rotate the rotor. This separation as well as the unbalance indications

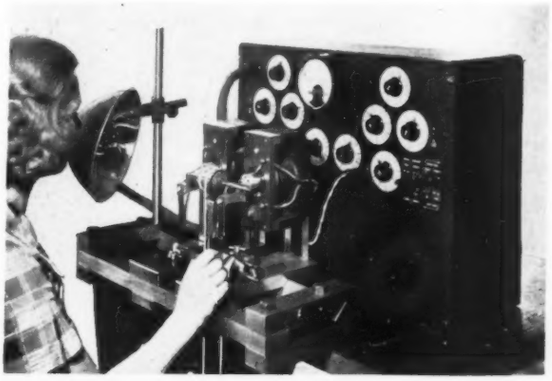


Fig. 6—Amount of unbalance in a machine part is read directly on a calibrated meter

now are made electrically. Because the unbalance force is not required to vibrate the mass of a carriage, the device is inherently more sensitive.

With the rotor spinning in the new balancing machine the only manipulation necessary is the operation of two electrical switches, giving direct readings of unbalance for both correction planes without the usual mechanical changes and without stopping the rotor. Also, all errors due to the vibration of the building are

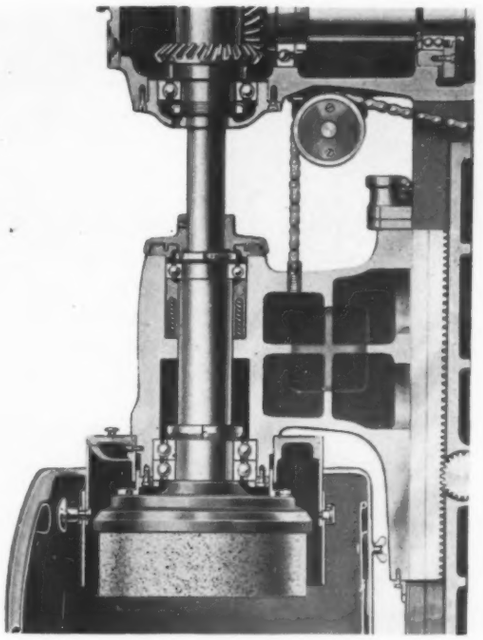


Fig. 7—Upward thrust of a spring-loaded sleeve provides preloading effect that obviates wheel sag

eliminated, even though the vibration might be at the frequency of rotation of the balancing machine. Better balance is produced with this machine, resulting in longer life of apparatus and more quiet operation than was possible with previous devices.

AUTOMATIC ADJUSTMENT WITH SPRINGS

COMPRESSION springs are employed effectively in a vertical surface grinder, *Fig.* 7, to carry the dead weight of the spindle and wheel parts, and to keep the spindle in automatic adjustment, preventing wheel sag. As the inner race of the upper single row ball bearing is mounted rigidly on the spindle, and the outer race is able to move axially within the machine housing, the upward thrust of the spring-loaded sleeve removes any looseness in the bearing, either initial or subsequent. Moreover, the idea enables variations in spindle length due to temperature changes to be compensated for without any strain on the spindle bearings.

Of extreme importance is the fact that the weight of the spindle and grinding wheel assembly is considerably overbalanced by the combined thrust of the springs in the sleeve. This arrangement is a feature of the Pratt & Whitney 14-inch hydraulic vertical surface grinder.

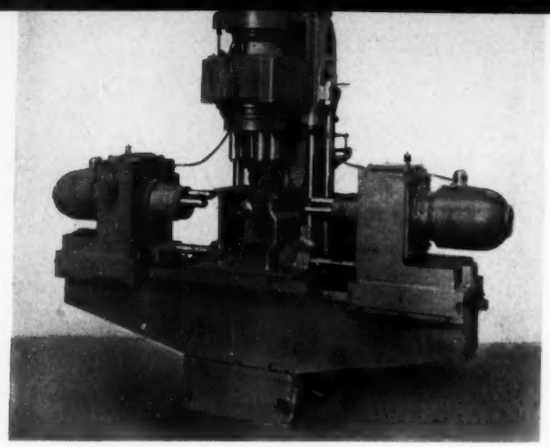


Fig. 1—Driven elements of the machine can be connected directly to the motor by the use of flange mountings

Flange Mounting Jumps to Forefront

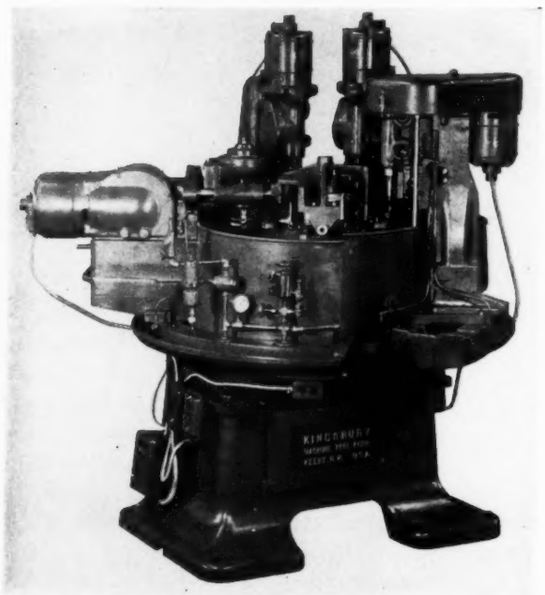


Fig. 2—With careful design, simplicity and neatness in the final machine is achieved

By Charles Foster

ONE of the most important decisions a designer must make is the type of motor to be used on his machine, and how this motor may be incorporated in his design. An incorrect choice may, in addition to causing lack of efficiency or poor operation, result in the complete failure of the machine when in competition with other designs.

The use of motors with flange-type end shields such as those shown on the head motors of the Baker Bros. three-way drilling machine in *Fig.* 1, makes possible the connection of the motor shaft directly to the driven elements of the machine, thus providing permanent and correct alignment, eliminating the use of connecting parts, and reducing the possibilities of vibration. In other designs, the flange-mounted motor may be integrally mounted on the machine and by means of chains, gears or belt, the power may be taken directly from the motor, again without the necessity for additional connecting parts.

This ability of flange-mounted motors to provide alignment of the drive shaft and the driven shaft, in the case of direct drive, and their tendency to insure close tolerance on the center distance between pinion and gear in the case of geared power transmission are among the greatest advantages to be gained from their use. The economy in this ease of alignment is obvious.

Another important advantage will be noted in the accompanying illustrations in the improved appearance of the completed machines. This advantage accrues from the fact that flange mounting enables the machine designer to build the power requirements into his machine as an integral part. The final product is of the maximum simplicity and neatness as can be seen in the Kingsbury drilling machine, *Fig.* 2. If another type of motor were used in this application, a separate and distinct mounting for the motor would be necessary. Such a mounting would restrict the functioning of the machine as it is not so convenient to provide for longitudinal motion of the entire drill-head.

The conventional design of flange-mounted motor has the mounting flange as a part of the end cover on the shaft extension end. Usually such designs include a machined projection which enters into a machined opening or recess

in the frame of the machine to which the motor is attached, thus insuring a high degree of concentricity in the mating parts. Provision is made in both the machine frame and the motor flange for the use of a number of ample size bolts which securely clamp the motor frame to the machine. The machine frame to which the motor is mounted must, of course, be of sufficient strength to support the overhanging weight of the motor and resist the torsional force acting through the motor frame. The mounting pad should be a point carefully watched by the designer. In most cases it is impossible to see inside of the machine once the motor is attached,

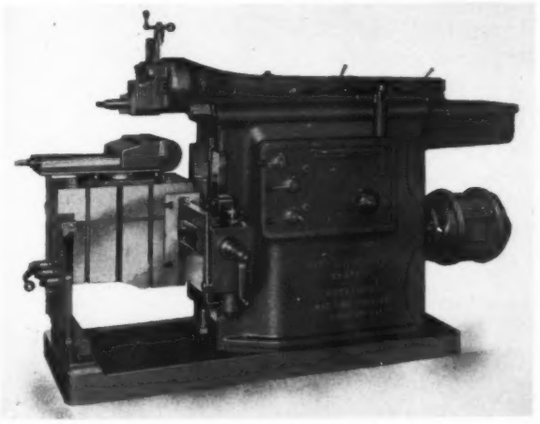


Fig. 3—Possible difficulty in aligning bearings is obviated by method of mounting

and inaccurate mating of gears may easily result from a poor mounting pad.

There is a wide variety of mounting flanges being manufactured by motor builders. However, unless the machine is especialy designed to fit one of the flange mountings available, the motor will have to be especially built to fit the machine, an expensive design step.

Despite the possible variance in flanges between manufacturers, individual motor builders have in most cases a standardized line of end shields. One motor manufacturer has designed end shields which have only four sets of mounting dimensions. Thus the same machine mounting permits a variety of motors of different ratings and characteristics to be used interchangeably on the machine. In this way the machine may be adapted, without change, to the use of single-phase, polyphase or direct current motors and to motors of open, splashproof, totally enclosed or totally enclosed fancooled types as well as those of Class II, Group G, or Class I, Group D construction according to Underwriters' requirements.

Flange-mounted motors of the horizontal type usually have bearing lubricating features common to other motors for horizontal operation. Packing boxes are of ample size, designed to prevent the loss of lubricant through leakage. Additional grease or oil may be supplied through lubricators, generally found on the motor side of the flange. Where the motor packing box is located far back into the machine frame, other means, such as an oil tube, must be provided to carry lubricant to the bearing reservoir.

The problem of lubrication brings up another factor which must be watched by the designer. In horizontally mounted flange motors which co-operate with gears inside of the machine, where these gears are operating in a bath of lubricant, steps must be taken to keep the gear lubricant from running back into the motor and entering the windings. Bearing seals will help prevent this, but another method of accomplishing the same end is to arrange the gear train so that the motor co-operates with the highest gear in the train. With this arrangement, the oil level inside of the machine may be kept below the opening for the motor shaft.

Should Insure Ventilation

In some flange-mounted motors, ventilation problems are encountered, and in the design of a machine consideration should be given to the most satisfactory means of motor cooling.

It would be difficult to outline a standard formula for the designer to use in specifying flange mounted motors—it is necessary that the machine designer and motor manufacturer work hand in hand to blend the design of the machine and available motor into one unit.

The primary information required by the motor manufacturer will be the horsepower required to operate the machine and the speed at

Fig. 4—Four-speed motors enable a number of drilling speeds to be obtained

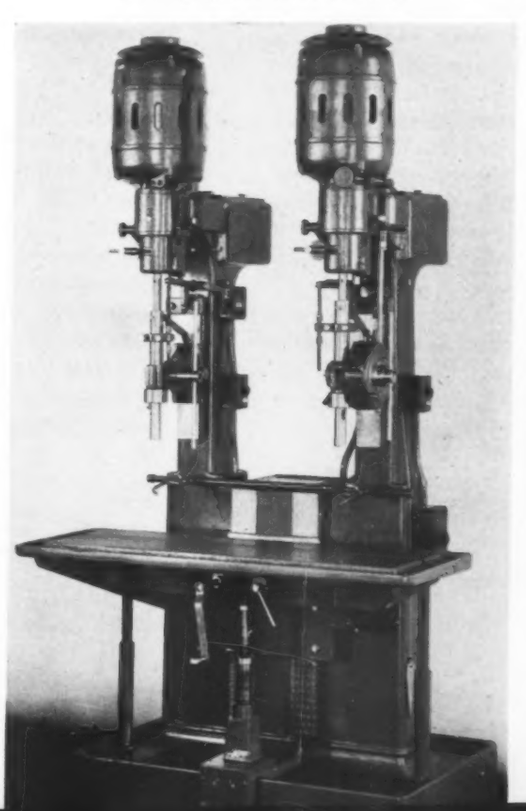


Fig. 5—Flange-mounted motor drives rolls through herringbone gears

which the motor is to operate.

Due to construction, the 1800 RPM rating is in practically all cases the cheaper motor and is the one that is normally used to operate equipment. When low speeds are required, a system of gears or chains built in by the machine manufacturer can be employed, and in cases where very low speeds are required, motorized gear reducers are considerably cheaper than

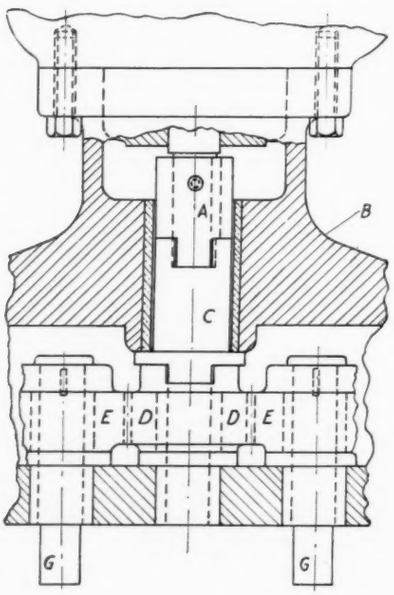


Fig. 6—Coupling method simplifies design in that proper alignment is insured

slow speed motors and require less space.

Standard squirrel cage motors have approximately 150 to 200 per cent starting torque and if more is required by the equipment manufacturer the motors may be easily built to give the desired torque by changing the resistance in the rotor. In order that the motor manufacturer may supply the correct motor it is essential for him to know the horsepower, speed, starting torque required, type of duty, that is, continuous or intermittent, etc., so that the motor having the correct electrical characteristics may be furnished. The use of standard designs saves both motor user and manufacturer the expense of special developments

In furnishing flange mounted motors the motor manufacturer should also have complete mounting dimensions if they are not standard. Along with the electrical and mounting requirements the motor builder must know whether the motor is to be of the open, splashproof, totally enclosed or totally enclosed fancooled type.

Considering the application of flange-mounted motors from the standpoint of what has been done, the designer of the Rockford Machine Tool

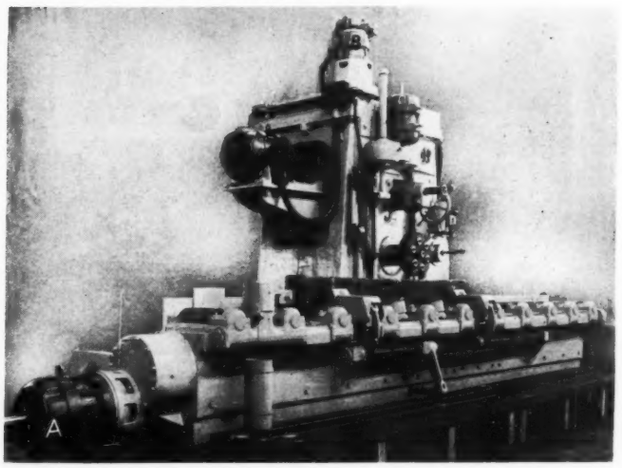


Fig. 7—Two-speed motor designed for quick and frequent starting drives the carriage

Co. hydraulic shaper, *Fig.* 3, considered a built-in motor using standard motor parts without the shaft and rear bracket assembly. This design was not favored because of anticipated difficulty in obtaining good alignment of three bearings on the same shaft. The flange mounted motor shown drives a pump which furnishes hydraulic power for operating the machine. The pump operates at motor speed and flange mounting permits the motor to be aligned correctly with the pump shaft saving the motor mounting base which would be necessary if the motor were foot mounted.

Vertical motors usually employ some form of flange mounting unless a belt take-up is neces-

(*Concluded on Page* 107)

Prominent Engineers View Machine Tool Developments

ELI WHITNEY — *Originator of interchangeable manufacture*

HENRY MAUDSLAY — *Inventor of the engine lathe*

AUTHORITATIVE analysis of the present status of machine tool design with a glance into the future was sought by MACHINE DESIGN from some of those on whom rests responsibility for engineering progress. Results, as the reader will observe in the following paragraphs, show a keenness of thought that augurs well for a new era of technology.

" . . . . . photocells have possibilities."

C. J. STILWELL, Vice President,

Warner & Swasey Co.

HYDRAULIC controls and drives, design of machines to closer tolerances, high speeds and increased power, are outstanding features that have come out of the past two years of machine tool development. Users are demanding greater accuracy as well as higher speed . . . . and engineers are meeting these requirements by more careful manufacture, better machines with which to produce parts, less clearances, improved finish on gears, etc.

Better cutting materials will be employed to take advantage of the higher speeds. More automaticity in feeds and speeds will be embodied in machines, with the number of levers required reduced considerably. A single lever will in the new equipment put the machine through its entire cycle. Set-up now is disproportionate in relation to the actual cutting time, another phase in machine tool design that will be improved. Excellent possibilities exist for the photoelectric cell, or electric eye, in machine design and I expect to see it used to great advantage.

" . . . . . higher accuracy is obtainable"

COLEMAN SELLERS III, Executive Engineer,

William Sellers & Co. Inc.

ATTAINMENT of increased accuracy is one of the noteworthy characteristics developed in machine tools over the past two years. Not only are the machines themselves capable of producing work to a closer tolerance but improved facilities for measuring and controlling the size of work are provided. Appearance is another phase in design where decided progress has been made. The outlines and the finish of new tools have been made more pleasing to the eye. Higher grade alloys in spindles, gears, etc., have been used more extensively. Flexibility of machine tools has been increased, this being noticeable principally in the increase of speed and feed range. Progress has been made also in refinement of the unit type machine.

The greatest development that has come out of the past two years has been the production type of tool and the smaller types of general purpose tools. It is my opinion that the next few years will see developments in the heavier types of machines such as planers, planer-type millers, vertical boring and turning mills. Sale of these tools has been curtailed greatly by business inactivity and they are due for progress. Lines of development will probably follow the trend toward increased speeds, ac-

curacy, improved appearance and greater use of electrical equipment.

" . . . . . electric controls reduce set-up time."

S. A. BRANDENBURG,

Monarch Machine Tool Co.

UNDOUBTEDLY the first of the two outstanding developments in machine tool design is the application of automatic metered lubrication on the ways of the bed on high grade toolroom lathes, as well as on production turning equipment. Ever since iron replaced the wooden bed, the carriage or saddle as it is sometimes called, has been allowed to wear away the accuracy of the bed before the remainder of the machine was well "run in."

Application of electrical controls to production equipment has been much discussed because they greatly reduce the so-called set-up time. Moreover, the rapid functioning of this type of control results in more pieces per hour. Many of these recent developments have done much to cause executive engineers to alter their sequence of design.

" . . . . . where is broaching headed?"

M. A. HOLLENGREEN, Assistant Chief Engineer

Landis Machine Co.

DEVELOPMENT activity in the field of broaching is the most outstanding accomplishment in recent years. A few years ago, it would have been considered fantastic to even suggest that broaching would encroach upon the field of the lathe, grinding machine or milling machine and in a number of cases produce better results. However, today just coming out of the experimental stages, we see the successful broaching of the main bearings for automobile crankshafts. In this case the finish turning of the lathe is eliminated as well as the finish grinding. Connecting rods now are broached to within 0.0003 inch.

Future machines will be heavier and more rigid to accommodate the new cutting tools such as carboloy, although the tungsten carbide tools are far from perfect at the present time. Development of the cutting tool and the machine tool will go hand in hand.

" . . . . trend points to multiple purpose units."

W. W. FINLAY, Production Engineer,

Wright Aeronautical Corp.

THE most important factor in the machine tool industry during the past few years has been the definite tendency away from the highly specialized single purpose machine and toward the more elastic type. I refer particularly to the built-in unit type. Advance of broaching is the most noteworthy development and those designs which have come to my attention are sufficiently elastic and adaptable to a wide range of jobs.

In regard to future trends, I am of the opinion that designers will continue to recognize the good economics of widely adaptable machinery; also still greater rigidity will be built into units. Use of long, large diameter plain bearings will become more general. There is a well defined field for automatic pressure lubricated plain bearings with a means for adjustment to enable clearance to be held to a close tolerance.

" . . . . . machines will be more universal."

A. E. DRISSNER, Engineering Vice President,

National Acme Co.

MACHINE tool builders who have had the courage to redesign their line thoroughly during the past few years have incorporated in these units countless refinements that enable the operator to make the fullest possible use of modern cutting metals and materials. For the moment at least, the machine tool of today is far ahead of the cutting tools available.

The future will probably bring further simplification of machines, moving from special purpose units toward the development of machines that are more nearly universal and which by the addition of simple attachments can be readily adapted to the economical production of a wide variety of products.

" . . . . more planning and styling is apparent."

L. BAKER, Works Manager,

Dexter Folder Co.

VIEWING developments that have come out of the past two years, I would say that the unit planning and styling project as carried out in the Ingersoll equipment (see page 27) is the most noteworthy. From my own standpoint, however, the most useful offering from machinery manufacturers during this period has been the facilities for obtaining torch-cut parts that can be readily welded into composite machines.

As to future trends, the course points toward further reduction in set-up time required in production. While many companies already have accomplished much in this direction, still more is imperative. To my mind there is a much wider field for automatic and semiautomatic units than actually is realized, particularly if these machines can be designed principally from the angle of reduced set-up time.

It's a Good Designer Who Knows His Materials!

By A. E. Drissner

Vice President and Chief Engineer, The National Acme Co.

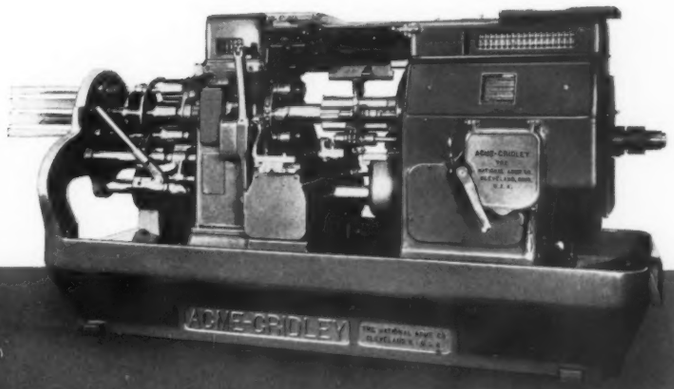


Fig. 1—Alloys steels supply the exact properties for many parts in automatic screw machines

ALLOY steels and castings, aluminum, brass, bronze and other of today's improved materials assure the success of modern machine tools. Materials, the basic commodity in which designs are interpreted, must be selected with care in order that the design will reach its foremost development. The great range of materials available makes selection easy, and this range enables the designer to choose exactly the correct material for his part.

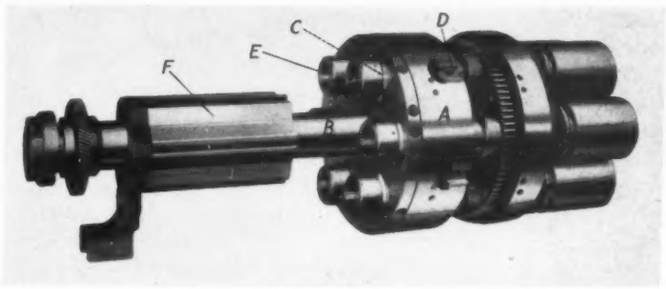


Fig. 2—Nickel irons and nickel-chromium steels are used to resist wear in this spindle carrier

In the design of the Gridley 4 and 6-spindle automatic screw machines, built by National Acme Co., it was essential that the base of the machine withstand heavy cuts without vibration. To make these heavier cuts possible, and to reduce machining time, the frame and pan of the machine shown in *Fig.* 1 are of box form, with a heavy top section to tie the gear section to the spindle carrier frame, making the entire machine one rigid unit. Modern high speed cutting tools can be used to their fullest capacity only when rigidly supported. The pan is the foundation of the machine. It is cast in one piece from semi-steel, selected to secure greatest possible strength and because this material permits a closer grained finish in the casting process. This piece is heavily ribbed and, like the other castings, is normalized before machining to eliminate warping and distortion. The base, headstock, gearbox and top plate are all cast from this semi-steel which is about 25 per cent steel.

The spindle carrier *A* in *Fig.* 2, is the heart of the machine. It must be properly constructed to get accurate work and long machine life. It is made of nickel iron with 1½ per cent nickel and 20 per cent steel. To insure accurate alignment, the stem, *B* in *Fig.* 2, the main tool slide support, is integral with the spindle carrier and is ground at the same setting as the carrier bearing surfaces. Holes for the spindle bearings, *C* in *Fig.* 2, are also ground to secure accuracy and positive alignment. For high strength and

Fig. 3—Unit for recording production and idle time utilizes aluminum die castings and stampings

workability, SAE 3115 steel, a nickel-chromium composition, was selected for the stem. This steel has C .10-.20, Mn .30-.60, Ni 1.00-1.50, Cr .45-.75, Si .15-.30, P .04 max, and S .05 max. The part is carburized, hardened and ground.

Spindle carrier stems are roughed, normalized and carburized, then bored out on the inside. The section at each end is then turned, they are hardened at all of the bearing points and then are ground all over. This provides a soft core with a hard exterior. Spindles, in the carrier are made from SAE 3115 steel, heat treated. These spindles ride on antifriction bearings. The main tool slide is of SAE 3140 alloy steel forging, machined and accurately ground all over. The hole in the spindle is bushed at each end with an oil reservoir in the center.

Locking blocks in the spindle carrier, *D* in *Fig.* 2, must take shock loads and must provide a hard surface with a soft core. Again SAE 3115 is used, carburized, hardened and ground. Special heat treated aluminum alloy castings are employed for the finger holder bodies. Selection of the material was based on the need for lightness with sufficient toughness to satisfy the operations. All parts subjected to wear are of alloy steel, hardened and ground.

As extreme strength is required in the locking pins in the carrier, and as these parts must withstand considerable shock load and compressive strain, vanadium steel is employed. Collet seats, *E* in *Fig.* 2, inside of the spindle nose also must withstand considerable wear and strain. They are fabricated from a chromium steel, SAE 52100 with C .95-1.10, Mn .20-.50, Cr 1.20-1.50, Si .15-.30, P .03 max and S .035 max. Collet material chosen to combat both wear and fatigue is SAE 4150, a molybdenum steel. Its composition is C .45-.55, Mn .60-.90, Cr .80-1.10, Mo .15-.30, P .04 max and S .05 max.

Employs Molybdenum Steel

This molybdenum steel is also employed for the gears in the carrier as well as for all other gears in the machine. The gears must be tough and must not wear to any considerable extent under severe and high speed. They are turned and bored, the teeth rough cut, finished, heat treated, then drawn to a hardness of 36 to 40 Rockwell. They are broached and ground. Finish cut of the teeth is then made from the holes after the heat treating operation to insure accurate and smooth running gears. Worms are also fabricated from SAE 4150, heat treated and hardened, while worm wheels are made from No. 62 bronze, a tough bronze composition with an analysis of Cu 62 to 65, Pb 2 to 4, Zn 31 to 36, Fe .50 max, Sn .10 max, and other impurities .25.

Additional bronze parts in the carrier assembly are the oil retainers, fabricated from the No. 62 bronze. Shoes and yokes are also of bronze, while pressed yellow brass is used for the nameplate. As the yellow brass is embossed easily, it makes an ideal material for this part.

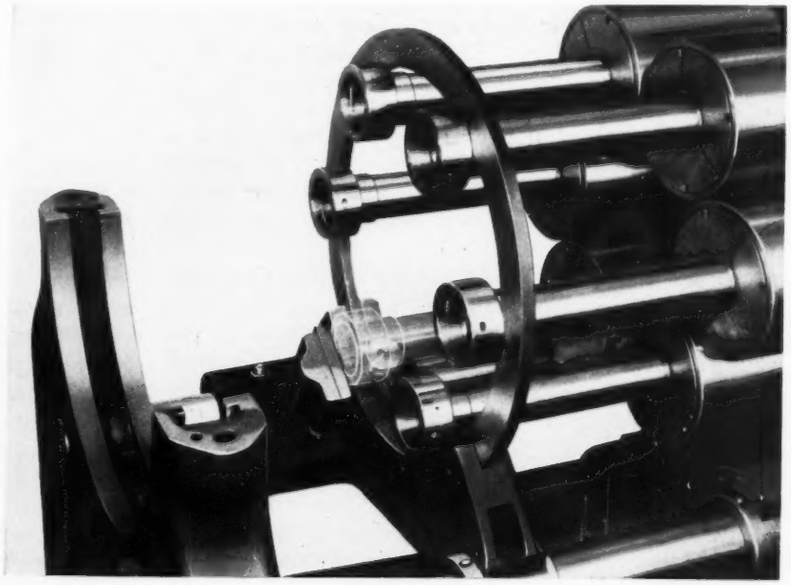


Fig. 4—Stock reels are formed from steel tubing, while end discs are steel castings

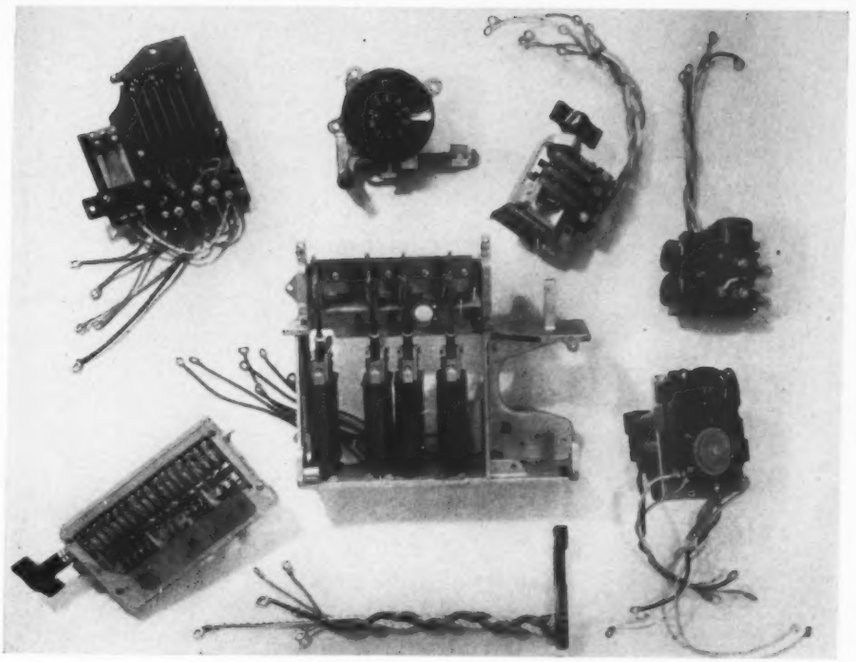


Fig. 5—Plastics satisfy the exacting requirements of many parts in the Chronolog, such as some of these shown

Checking shoes for operating finger holders and collets are of special alloy bronze, but incorporated as an integral part of these shoes are bone fiber inserts. These inserts assure greater resistance to wear.

Aluminum, which gives lightness and simplifies handling, is used for doors and covers wherever the part is not liable to be subjected to impact loads. Where impact may be encountered, sheet steel gives a strong durable cover. Splash guards, chip separating plates in the bottom of the pan, and guards on the machine are also of sheet steel.

Running over some of the other parts in the machine, where the selection of material was made to satisfy special requirements, we find that clutch plates are alternately steel and hard bronze. No lining is used as the clutches are exposed to oil. Springs are made from standard spring steel. Screws carrying any load or shock are of SAE 3115 alloy steel and are heat treated and hardened. Screws holding covers and guards are of SAE 1115 screw stock. Handles are of cast steel, cross slides of nickel iron.

Cam Rolls Must Resist Wear

Perhaps the greatest resistance to wear in the machine must be provided by the cam rolls and studs. These are fabricated from alloy steel, heat treated, hardened and ground, and this method of fabrication has been found to be quite satisfactory. Cams are machined from steel castings of SAE 3140 which have a minimum of .45 C. Where cams are subjected to extreme conditions of wear they are hardened. This composition was selected to withstand pressure and wear and for its ability to react to heat treatment. All shafts are made of alloy steel while the spline shafts are heat treated. Material generally used in shafting is SAE 3140. Fast moving shafts turn on antifriction bearings.

An important element of these automatic screw machines is the stock reel and associated parts. The reel itself is made from steel tubing while the ends or disks are steel castings. Pusher tubes and collet tubes, *Fig.* 4, part of the spindles assembly are of SAE 3115 while the pushers, which must be hard and have considerable elasticity, are made from SAE 4150. Cold rolled SAE 1020 steel with C .15-.25, Mn .30-60, P .045 max, and S .055 max, is amply strong enough for the rods and links.

Oil Lines Are of Copper Tubing

Additional materials employed in the machines include copper tubing for the oil lines, steel pipe with the usual fittings for carrying the coolant, and flexible steel hose for directing the coolant to the tools.

A unit which may be built into these automatic screw machines, as well as all other types of production machinery, and one which is an additional example of the interesting use of materials is the Chronolog, *Fig.* 3, a unit for recording production and idle time. In this device aluminum die castings are utilized for both sides of the case, the frames, and also for a number of the smaller parts. This material was selected for its light weight and for ease of forming with a minimum of machining.

Due to the accuracy necessary, machined steel rings with engraved characters are used for the registering wheels. Practically all other parts are made up of stampings or plastic materials, as shown in *Fig.* 5.

In this discussion of the materials used on the automatic screw machine, it can be seen that metallurgists and chemists have made available a material for every specification, no matter how varied. If none of the better known materials or alloys solve the design problem, it is entirely possible that a combination not so well known can be selected. Consultation with materials makers will often reveal a composition that is exactly what is needed.

Engineered Bearing Applications Predict Future Trends

By Allen F. Clark

REGARDLESS of the results of computations, the truth of suppositions, or the value of hunches, the actual worth of any design can be determined only after design ideas are built into the machine and tested under production conditions. Experience with past designs and other types of machinery often provides the basis of ideas for new ones; present designs incubate future innovations.

Machine tools, with their demand for higher and higher speeds, accurate and still more accurate production, and fast moving changes to keep pace with the work to be done were among the first to take advantage of the characteristics of ball and roller bearings. Being among the first, it is only natural that today's machine tools incorporate bearing applications that are among the foremost in design ingenuity. Bearings on production machines must satisfy stringent regulations that will brook no change. Their almost universal use on machine tools foreshadows their increased adaptation in the design of many other types of machines—machines that may be, as yet, nebulous ideas in the minds of designers.

Bearing Carries Endwise Float

The use of precision cylindrical roller bearings at the floating end of a milling machine spindle is shown in *Fig.* 1. This type of main spindle design can be used with lathes as well as many other types of machine tools. By using this separable type of Norma-Hoffmann roller bearing, it is possible to clamp the outer ring of the bearing rigidly in the housing. The inner ring assembly is, of course, clamped endwise and rigidly mounted. The endwise float of the spindle to take care of expansion and contraction is carried within the roller bearing itself, between the rollers and the outer ring. By setting

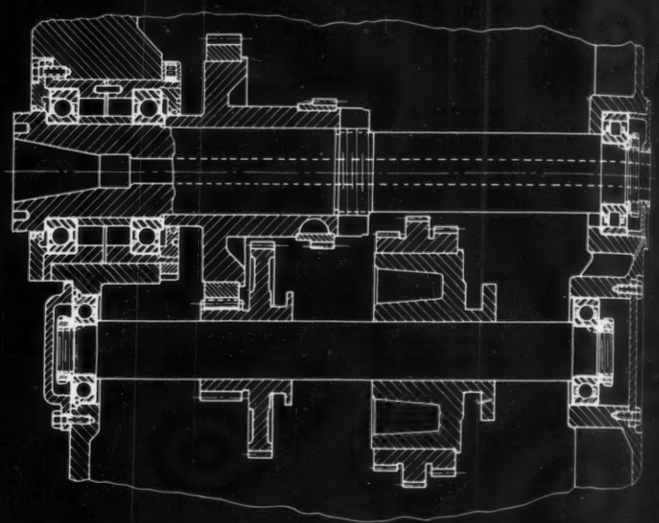


Fig. 1—Angular contact ball bearings may be adjusted to produce a definite amount of preload

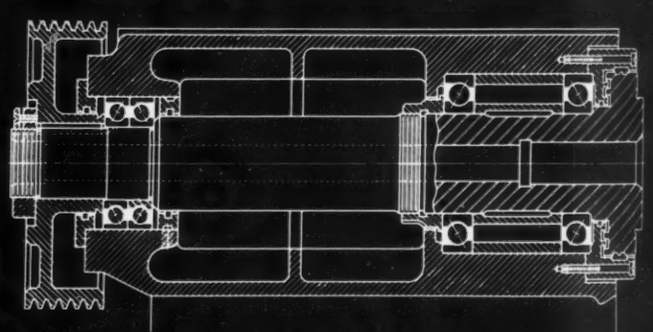


Fig. 2—Precision bearings have proved successful on airplane cylinder grinders with large overhang

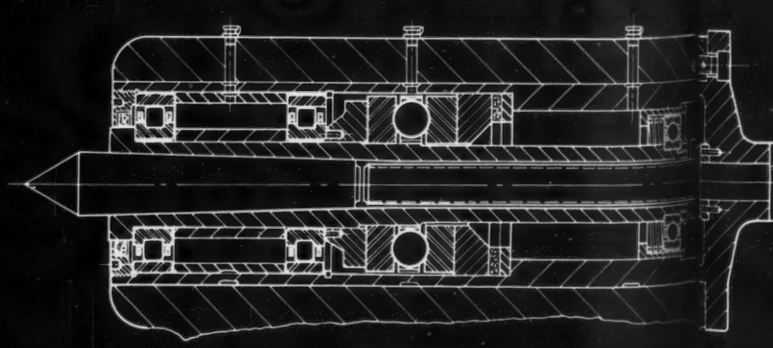


Fig. 3—Radial load is carried on two roller bearings that are spaced well apart

up the roller bearing with practically no internal clearance it is, therefore, possible to almost eliminate radial looseness in the bearing at the floating end. In a self-contained bearing it is necessary to have looseness between the outer ring of the bearing and the housing to permit endwise float.

The second feature of the spindle mounting itself, *Fig.* 1, is the interesting method of adjusting angular contact ball bearings to provide a certain amount of preload, thereby avoiding deflection of the bearings and spindle under the working load. The bearings are spaced somewhat apart to provide stiffness to the spindle. It will be noted that the threaded bushing for the rear bearing can be adjusted outwardly and thereby exert pressure through the two bearings and build up the required preloaded condition. A locking device is provided to hold the adjustment once it is made.

Bearings Are of Shouldered Type

A third feature of this milling machine spindle is the use of the snap wire or shouldered type of ball bearing on the countershaft. By means of the rectangular wire that fits in a groove in the outer ring of the bearing it is possible to have a through bore (without shoulders) in the housing. The bearing is clamped between one face of the snap wire and the opposite face of the bearing outer ring.

Another application of bearings to secure extreme precision is on a large work head, *Fig.* 2. This design, employing MRC precision bearings, has proved successful on airplane cylinder grinders with large overhang and extremely close tolerances, with the quality of the grinding being so good that lapping of the cylinder has been almost entirely eliminated. Note the spread bearings at the nose with considerable preload ground into them to stiffen the relatively long spindle.

Radial load is carried on two roller bearings that are spaced well apart to provide rigidity on the longer heavy duty lathe center shown in *Fig.* 3. These Norma-Hoffmann bearings have the outer rings clamped endwise and mounted with a light interference fit in the housing. The spacing of the roller bearings provides for increased rigidity of the spindle. The roller bearings are furnished, of course, with only sufficient radial clearance to permit them to rotate freely.

The thrust in the spindle shown in *Fig.* 3 is carried against the large heavy duty ball thrust bearing which is in turn seated against a compressed leather disk. The purpose of this disk is to absorb the excessive thrust load due to the expansion of the part being processed. Another feature of this mounting is the spring adjustment at the back end ball bearing by means of which the large ball thrust bearing is kept in its properly adjusted position so that the retainer and the balls cannot drop downward into the grooves of the thrust bearing.

In the spindle for a precision bench lathe, *Fig.* 4, the designer's problem was to obtain extreme accuracy under all conditions including high speed operation. Ordinarily, with front and rear bearing housings bored so as to leave locating shoulders for the bearings, it is necessary to bore the housings separately from each end, and to do this and maintain precise alignment is difficult. With the New Departure flanged precision ball bearings used, however, it is possible to bore both housings straight through from one side and at one operation and obtain a high degree of accuracy.

Simplified Bearing Assembly

Simplified assembly is also the aim in the design of the high speed lathe spindle, *Fig.* 5. Lubriseal shielded single row bearings at the rear with a flinger make a simple assembly. MRC duplex bearings back to back at the nose provide endwise and radial rigidity.

A large boring machine spindle, typical of heavy duty spindles with large speed variation is shown in *Fig.* 6. In this design the particular value of the ball bearing is that it permits higher speeds, yet retains enough preload to have satisfactory cutting at low speeds. The spindle is relatively short for its diameter. Hence the

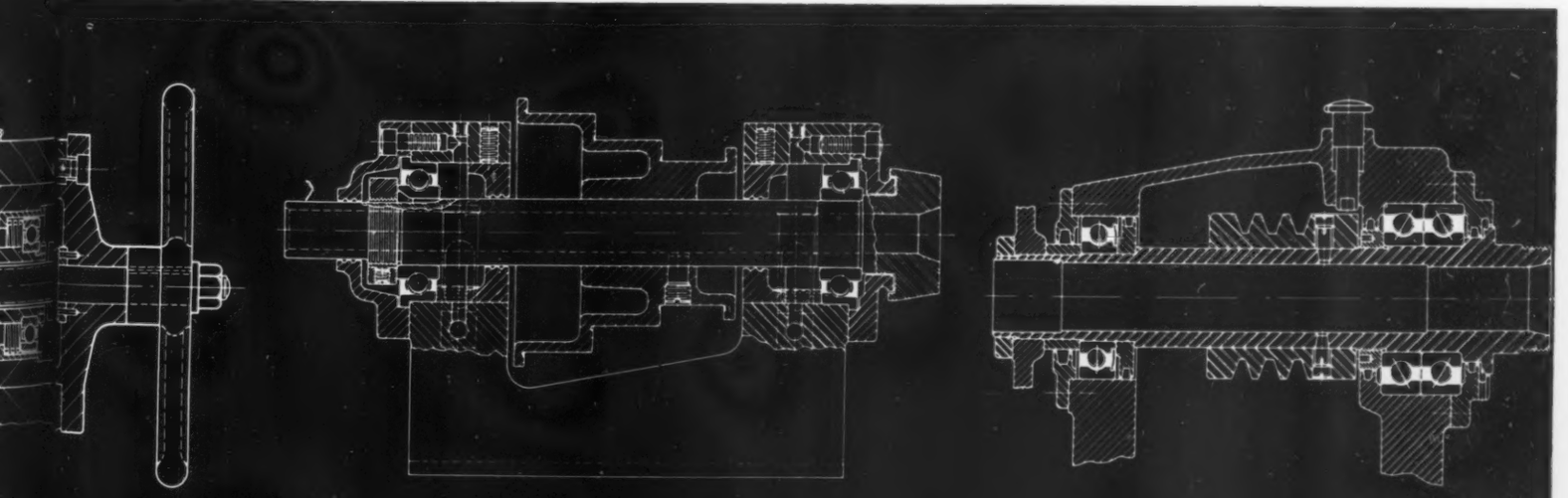


Fig. 4—Flanged ball bearings make it possible to bore both housings straight through from one end

Fig. 5—Shielded single row bearings at the rear of the flinger make an easy assembly

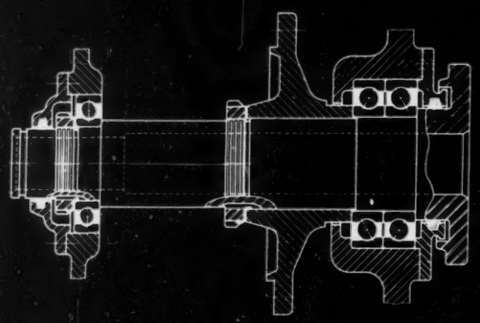


Fig. 6—As the spindle is relatively short for its diameter, bearings need not be spread

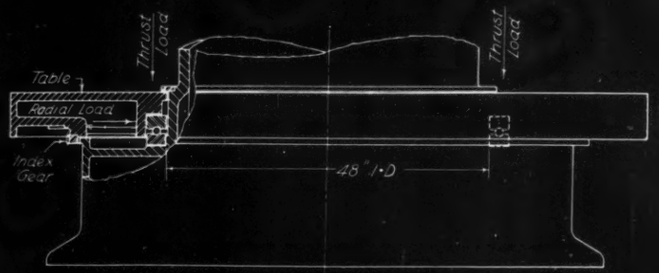


Fig. 7—By using a deep groove construction the radial load is easily accommodated and concentricity requirements are satisfied

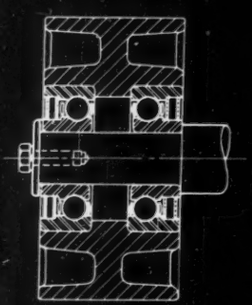
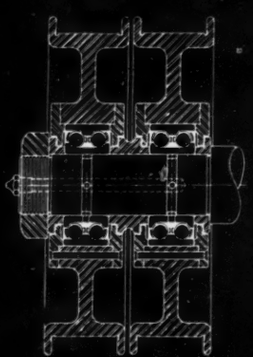


Fig. 8—Adequate protection is provided the bearings by use of felt seals, while a large grease reservoir is located between the bearings

Fig. 9—Preloaded double row bearings are utilized in loose pulley mounting. The design permits periodical lubrication from a central source



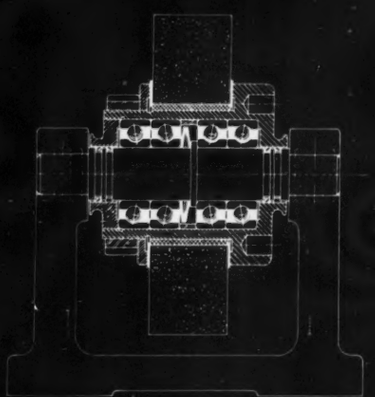


Fig. 10—Washer type springs provide convenient take-up where space is limited

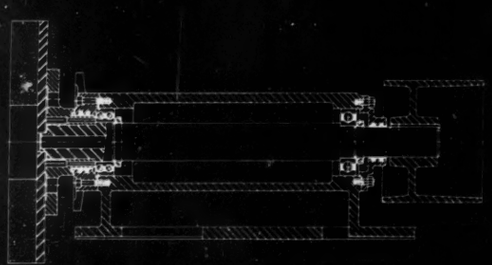


Fig. 11—Efficient housing design enables use of same diameter bearings

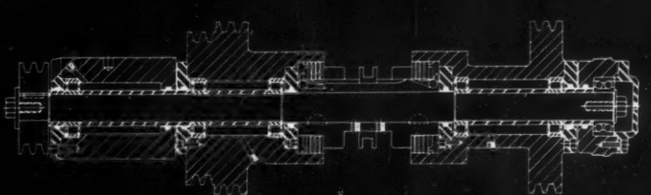


Fig. 12—Shaft sleeves space the bearings in simplified mounting design

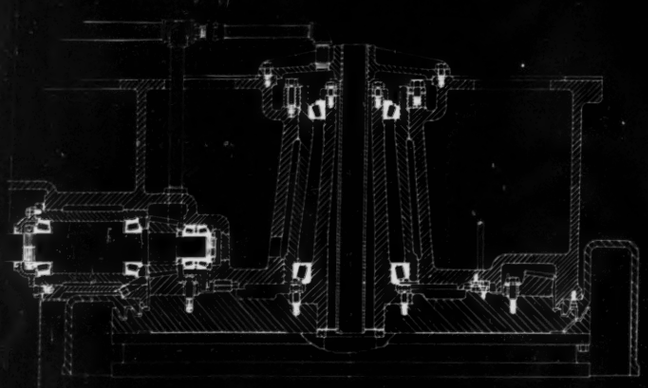


Fig. 13—Both assembly and disassembly are facilitated and machine work on the housing is made simpler by design of bearings

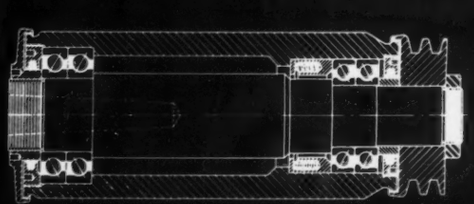


Fig. 14—Two bearings in parallel divide the load equally and thus double the rigidity

bearings at the nose need not be spread. A standard MRC duplex bearing with initial end preload is satisfactory.

The requirement that each boring operation be held within a limit of 0.001-inch in the special automatic multioperation boring and reaming machine built by Hammond Mfg. Co., brought about the design of the special Bantam ball thrust bearing of *Fig.* 7. This bearing is 54 inches outer diameter by 48 inches inner diameter by 4½ inches thick. The problem encountered in this design was to obtain an antifriction bearing of suitable diameter to permit a rigid construction of the machine column, of thrust capacity for seven tons dead load plus tool pressure, a parallelism held within 0.002, of radial capacity to accommodate pressure of indexing gears, of concentricity (runout) not to exceed 0.001 and of economical construction. The ball thrust bearing satisfied the first three items, but standard ball thrust construction would not fulfill the requirements of radial capacity and concentricity. By using a deep groove construction the radial load is easily accommodated and the concentricity is held within specified limits.

Bearing Insures Accuracy

Another instance of an unusually large bearing used to insure extreme accuracy is in the rotating table of the grinding machine for grinding an 120-inch reflecting mirror. This machine consists essentially of a rotating table operating at from ¼ to 1 revolution per minute on which the mirror is placed. The main spindle of this table is supported on two SKF ball bearings having a bore of 27 inches, an outer diameter of 33 inches and a width of 2 inches. The mirror is being ground to the finest possible limits of accuracy.

A very simple type of idler pulley mounting which gives adequate protection provided by means of felt seals and which has a large reservoir for grease between the bearings is shown in *Fig.* 8. No provision for additional lubrication has been made in this design as it is anticipated that the original filling of grease will last for years under average conditions on account of the amount of grease that can be put into the pulley hub at the time the assembly is made. The outer rings of the Norma-Hoffmann bearings, since they are in rotation, are clamped endwise. The inner rings are not clamped, and there is a clearance between the cover disk on the end of the shaft and the bearing inner ring to prevent cramping the bearings endwise.

Preloaded double row bearings are utilized in the loose pulley mounting of *Fig.* 9. The New Departure bearings are so designed as to permit lubrication from a central source through holes in the bearing inner races communicating directly with the balls and separators. Because of their thorough enclosure, it is possible to mount these bearings without provision for future disassembly; that is, the clamping pieces on each side of the pulleys are riveted in place. Lubrication of such pulleys is seldom necessary oftener than once a year.

Employs Duplex Bearings

Duplex bearings are used to provide extreme rigidity under severe service on the wheel dresser, *Fig.* 10. Belleville washer type springs provide the spring take-up. This type of take-up is quite convenient where space is limited.

A double end disk grinder using the new snap ring groove bearing in order to secure an efficient housing design is illustrated in *Fig.* 11. Both MRC bearings have the same outer diameter and the bore is straight through. As extreme accuracy is not required, double row angular contact bearings with internal preload have proved successful.

Another simplified mounting is achieved by the design of the clutch drive shaft for a centerless grinder, *Fig.* 12. One size of Hyatt solid roller radial bearing is used throughout. Bearings are spaced by means of shaft sleeves.

Smoothness of operation and accuracy is provided by the Niles boring mill spindle mounting of *Fig.* 13. This design being such as to enable assembly from the top, both assembly and disassembly are facilitated and machine work on the housing is made easy. The spindle carries Timken cone and roll assemblies at both ends, the upper cone backing against a shoulder on the spindle. A spindle carrier holds the cups, both upper and lower cups seating against shoulders machined in the carrier. Adjustment of the spindle bearings is secured through an end plate and shims at the bottom of the spindle. The bearings are preloaded. Final adjustment of the table against the track may be made to a high degree of accuracy by properly adjusting and clamping a nut on the threads provided at the bottom of the spindle carrier.

Produces Fine Finish

Typical of a group of spindles that have solved a difficult problem is the diamond boring spindle, *Fig.* 14. The plain bearing diamond boring spindle has produced a fine finish resembling lapping. It was almost impossible to do this with a ball bearing spindle until the design shown was perfected. Spring load of the MRC bearings is in the neighborhood of around 500 to 600 pounds. Two bearings in parallel at each end give the rigidity and support of both rows of balls for radial loads or thrust loads in either direction or combination. The large number of points of support provide extreme accuracy and rigidity. Two bearings in parallel divide the load equally and thus double the rigidity.

Designers' Problem w

Steel in M

By Robert E. Kinkead
Consulting Engineer, Welding

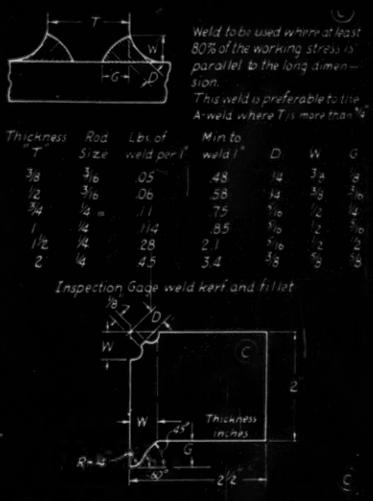


Fig. 1—Designers use from 20 to 30 standard welds such as this. Time required is for uninterrupted operation. Gage is used for inspection

THE MACHINE tool designer who has designed parts to be made in castings has the necessary background to design parts made of welded steel assemblies. Some years ago the opinion was commonly held that welded steel construction had to be designed by men of specialized training in welding and welded design. At the present time, several hundred designers are doing creditable work in welded steel construction with little or no previous experience with this class of construction. It is the purpose of this article to deal with the mental approach to the job of designing and building welded parts for machinery of the class of machine tools, which makes it possible for a machine designer to get entirely satisfactory results without previous welding experience. Such a mental approach has been established among many designers with whom we have worked. The methods and ideas developed in connection with doing the job are born of experience and it is only fair to say that most of the theories we originally employed have had to be thrown overboard.

The designer's usual belief that he cannot do a creditable job of design in welded steel construction may readily be displaced by completely removing knowledge of welding as a factor in the design job. This is accomplished by placing at the designer's disposal a list of standard welds which will cover practically every kind of a joint he may want to use. The kind of loading for which the different joints may be used is specified on each sheet. He merely designates the type of welded joint he wants by a symbol on the drawing. The necessities of the mechanical design determine the kind of welded joint required, so the designer has been completely freed from any further consideration of the tech-

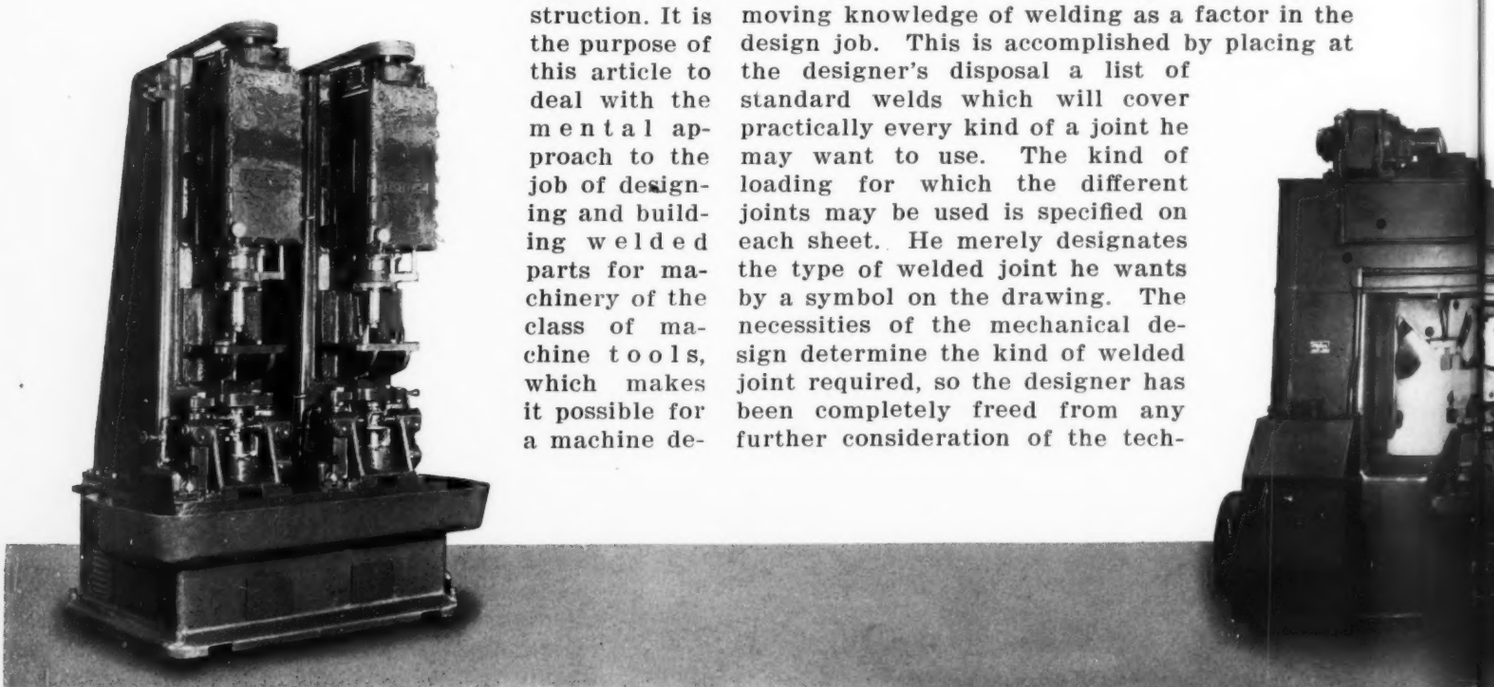


Fig. 2—Ex-Cell-O machine for facing and counterboring includes welded steel columns

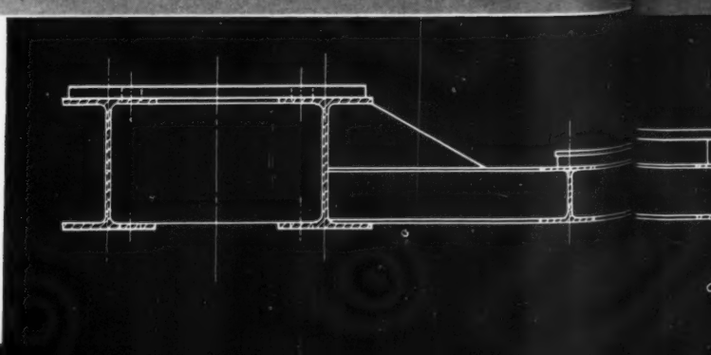


Fig. 3—(Above, Center)—Motor is mounted on welded steel top rail

em with Welded in Machine Tools

THE broad viewpoint of a professional engineer who deals in a responsible way with welded steel construction is presented in this article on the solution of welding problems. Mr. Kinkead, a consulting engineer who specializes in welding, has worked with designers of a great many forms of machinery and has served as a consultant with welding fabricators.

nical details involved in the welding. Different kinds of welds are so completely specified that when the designer calls for a C weld, *Fig.* 1, for instance, the shop will know precisely what kind of a weld to make.

The important knowledge the machine tool designer has is:

What he must accomplish with the part being designed.

The service life required, rigidity, freedom from vibration, strength, desirable weight, etc.

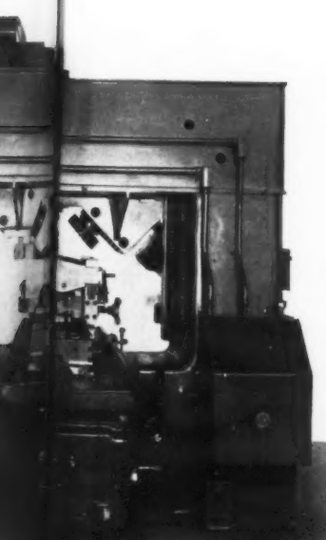
Permissible cost.

The physical properties of metals such as strength, yield point, modulus of elasticity.

This fundamental knowledge forms the basis of the design. Any welding used is incidental to the main job.

In the transition period, during which the designer is trying out welded steel assemblies to find out whether they offer advantages as compared with other types of construction, it has been found advantageous to make the drawing as if the job were to be made of a casting. From this drawing the designer works out several possible assemblies of steel pieces which, when welded together, will serve the same purpose as the casting. It is at this point that the greatest trouble occurs and, again, the difficulties have nothing whatever to do with welding.

If the job has been designed as a casting, curves and complications in general will make it difficult to reproduce exactly in welded steel construction without prohibitive cost. The problem at this point is one of simplification. If the welded steel assembly parts are to be made in a shop which has flanging press, bending rolls and bending brake, many problems of curves and contour complications may be solved. Machine gas flame cutting is another escape from many situations. The trouble in which the designer finds himslf arises from one of two causes; either his shop does not have the necessary cutting and forming equipment, or he does not know what can be accomplished with such equipment. The solution in either case is to



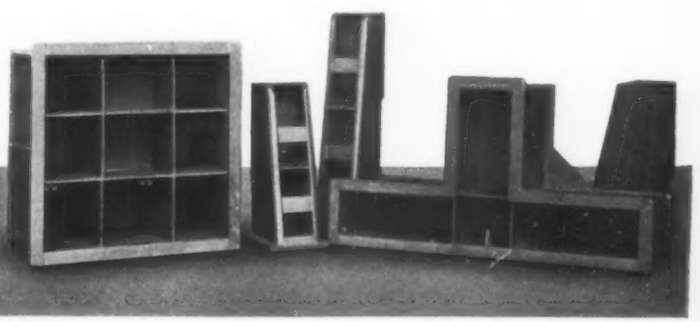


Fig. 5—Typical welded steel bases and columns designed for special machinery

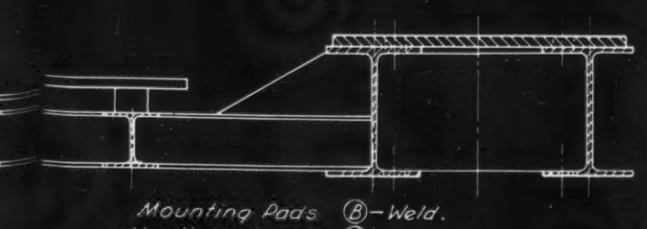


Fig. 4 — Base of machine which lends itself fully to welded construction

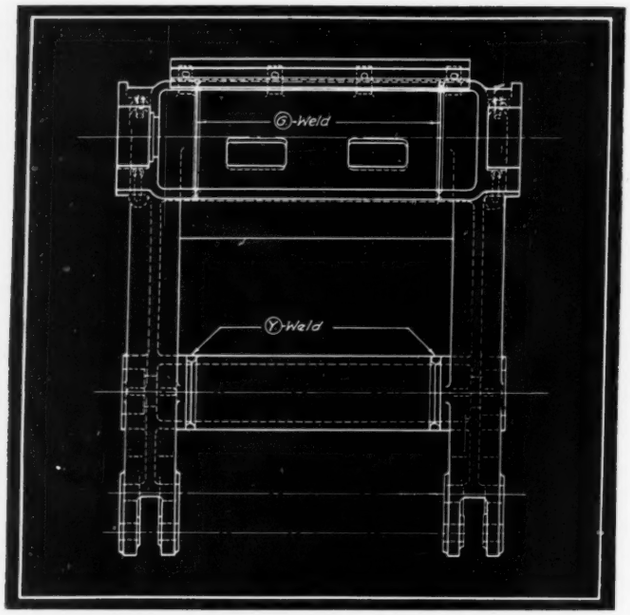


Fig. 6—Side arms of double rocker arm are made of steel castings, tubular cross member is seamless steel tubing, semi-tubular members of pressed plate is welded to the side arms. The part is stress relieved

make contact with a shop which has this equipment and experience, and have this shop do the cutting and forming and possibly the welding.

Cost is the guide the designer follows, of necessity. If a pattern for a casting is available, it is often difficult to meet the cost with welded steel. Following the guide of cost the designer should use, without restriction, steel castings as a part of the welded assembly. Thus in *Fig.* 6, welded steel is incorporated in what is essentially a casting job for the sole reason that the best result is so obtained for the least cost. *Fig.* 8 shows another application of the same idea where the base is a composite of rolled steel plate and castings. Either all-casting or all-welded steel would cost more than the final design. *Fig.* 4 shows an all-welded design with its typical simplification. In a case of this kind, steel castings could not compete even though the pattern was available.

Few Shops Completely Equipped

The difficulties just described are very real but are, for the most part, the kind the designer is accustomed to overcome. No small part of his problem is due to the fact that there are very few shops in the country that are completely equipped to form steel for welded assemblies.

The impression is general that it is only necessary to buy a welding machine to make parts of welded steel construction. It is true that some of the simple assemblies made of flat plate and structural shapes can be produced in this way, but the scope is severely limited, particularly on machine tool work. A shop to make welded machinery parts without restriction needs, among other things—plenty of floor space, machine flame cutter, flanging press, bending rolls, bending brake, manipulators to handle the job during fit-up and welding, and in many cases an annealing furnace. The capital investment of a welding shop to produce welded steel assemblies on an efficient basis is comparable to the cost of a steel foundry and pattern shop. This general statement of the case is given on the general theory that if the designer knows why the difficulties occur he can either find a solution or label the case as one which cannot be solved by welded steel.

Pleasing Appearance Essential

Good appearance is related to the problems which have been discussed. If the designer is confined to flat plates and structural shapes, many parts cannot be made in welded steel and have satisfactory appearance. Pleasing appearance is essential. Good mechanical design will give pleasing appearance and it usually is unnecessary to go beyond the bounds of correct mechanical design to get this effect.

Figs. 2, 3, 5 and 7 show rational uses of welded steel in machine tool design to meet special requirements of the user by adaptation of standard machines. By proper specification of the welds, the designer is assured that the welded part will conform in appearance with the machine as a whole.

Problems of shop production of welded steel construction are outside the field in which the designer normally works. There is no more reason why the designer should be concerned to a greater extent with the problems of operating a welding shop than with the problems of oper-

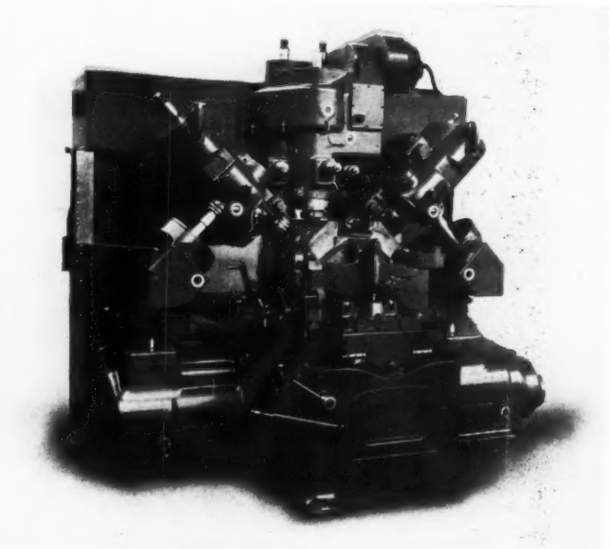


Fig. 7—Top rail of special Cincinnati Hydromatic, also shown in Fig. 3, is fabricated by welding

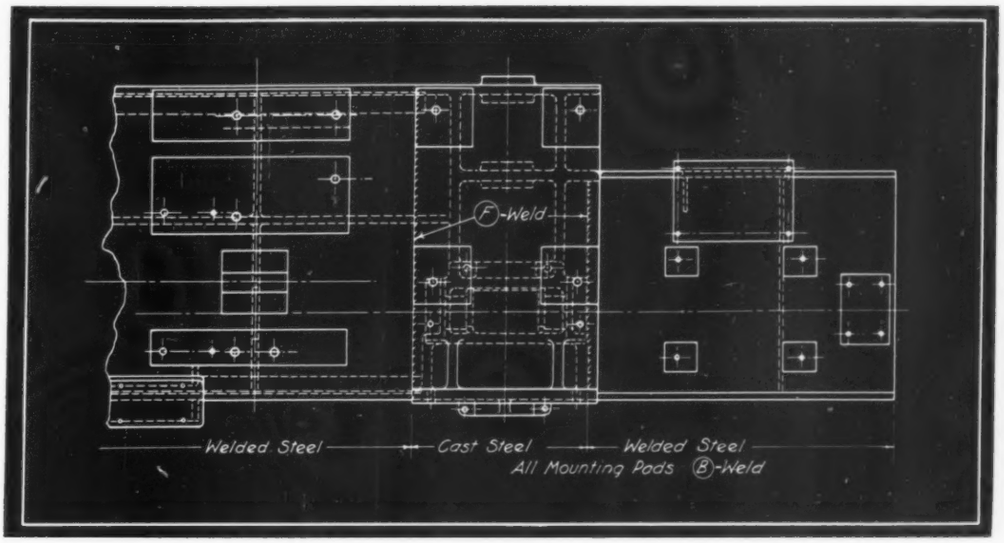


Fig. 8—Steel casting is used in assembly of unloader frame at point where complications in shape would make welded steel more costly

ating a foundry. The designer should have about the same degree of contact with the welding shop as with the foundry so that practical suggestions coming from the welding division may receive proper consideration.

The matter of when to specify stress relieving of welded steel assemblies is not difficult to handle in the field of precision machine frames and parts which must not change dimensions in service. Such parts should be stress relieved preferably by heat. The whole subject is somewhat controversial at the present time in the welding field but there is no doubt about the fact that a welded assembly will behave like a "green" casting if it is not properly stress relieved.

Should Require Slow Cooling

The difficulty with furnace stress relieving arises from the fact that with improper handling the job will have more stresses in it after "stress relieving" than it had before. Where there is a wide difference in thickness of the parts of an assembly, heating to 1200 degrees and holding it for one hour per inch of thickness, then cooling to 400 degrees Fahr. in the furnace, then cooling in still air will leave the assembly in bad condition so far as internal stresses are concerned. In such cases, the specification should require slow cooling in the furnace until the hottest part is not over 100 degrees Fahr. and then removal from the furnace. This involves extra expense as compared with what passes for stress relieving in many cases but the cost should be considered legitimate if the part is to be used on a precision machine.

Specification of the finish of the welded assembly again depends on the character of the machine of which it is a part. Sand blasting will permit of a better paint job after it is finished. A symbol designation may be used to specify that all sharp corners are to be removed. In rough machinery such requirements are omitted although it has been found that fine finish of the parts of a machine on which the eye would casually rest adds a great deal to the appearance of the job as a whole. So far as the welds themselves are concerned, if they are required to be made with shielded arc welding rod in the downward position they will have good appearance.

Welded Design Not Difficult

Welded assemblies for use in machines of the general class of machine tools are not particularly difficult to design and cover with specifications which will give assurance that the shop will understand what is required. The problem is to get delivery on such construction at a price which makes its use economical. This situation, as has been stated before, is due largely to the relatively small number of shops which have all of the equipment necessary to do the work.

As the matter stands at the present time, the machine designer is confronted with a noticeable trend towards the use of steel for machinery parts. Steel castings alone do not solve all problems by a large margin. Welded steel construction of suitable quality is expensive. Composite assemblies of steel castings and rolled steel welded together often meet the necessities of cost but leave a good deal to be desired in the matter of appearance of precision machinery. As the flow of capital returns to investment in plant and equipment, it seems entirely likely that both privately owned welding shops and those which do commercial work on a jobbing basis will be better equipped. The net result of better equipment will be that the designer may use welded assemblies without restriction for any purpose with the assurance that they will be built at an economical cost.

Fig. 1—Where accuracy in production counts

Tying in Design with the Shop

By F. E. Dennison
York Ice Machinery Corp.

DESIGN is one phase of manufacture and production is another, but the two now are so closely allied that problems of either must be considered from the standpoint of both. It is easy enough for the designer to specify such tolerances as plus or minus 0.0001 inch on the drawings and then go merrily along in the illusion that they are being maintained. What happens, more often than not, is that these close tolerances are being ignored in the shop.

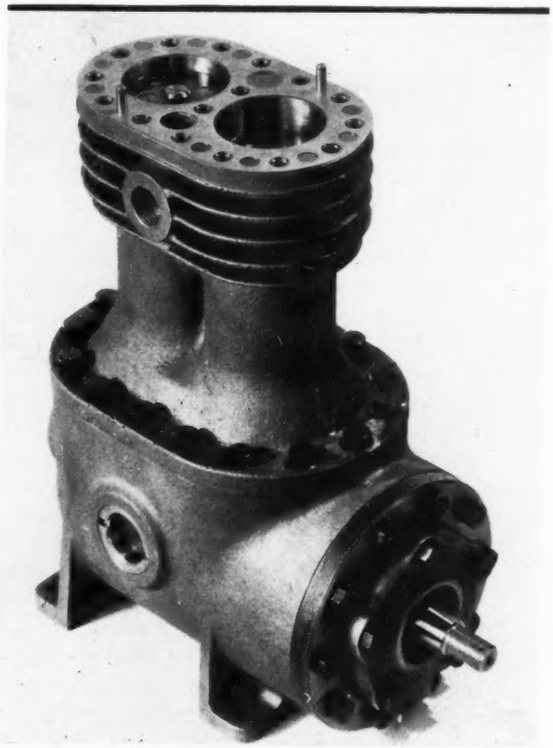
The greatest difficulties encountered lie with both men and machines, for it is impossible, of course, to obtain a production part with tolerances any closer than that of the machine itself, or finer than the ability of the man to measure the part. Some will say that the solution is easy; just provide "go" and "no go" gages. In actual practice, however, if the engineer will try gaging a finished hole with a plug having the "no go" size 0.0001 inch larger than the "go" size, it will become apparent immediately that the human element is of great importance.

A more forceful demonstration of this is to have a number of parts manufactured and gaged by different workers. Then collect all the parts together for examination and appearance. It will be quite an odd lot of sizes because of the difference in personal opinion of the various men that gaged the parts. They will be even more diverse, of course, if different types of production machines are used. That the problem lies in the proper training of men in the use of machines and their measuring devices can be shown still further by another experiment. Send a finished part, such as one of those depicted in *Fig.* 1, through the shop, asking various men who are not specially trained on that particular piece to measure it and send you the result of their measurements. The divergence of opinion will be amazing.

Another highly elusive feature in the production of any finished part is the problem of imparting a proper finish to it. Just what is "smooth fine" finish, a "polish" finish or the various other expressions used to indicate what is desired in the finished product? Here again both man and machine play the leading role.

The importance of training men on each new design is absolutely necessary, and the success of the design depends largely on this training.

Fig. 2—Skill produced these York cylinders



Controls Should Be Built In—Not Hung On!

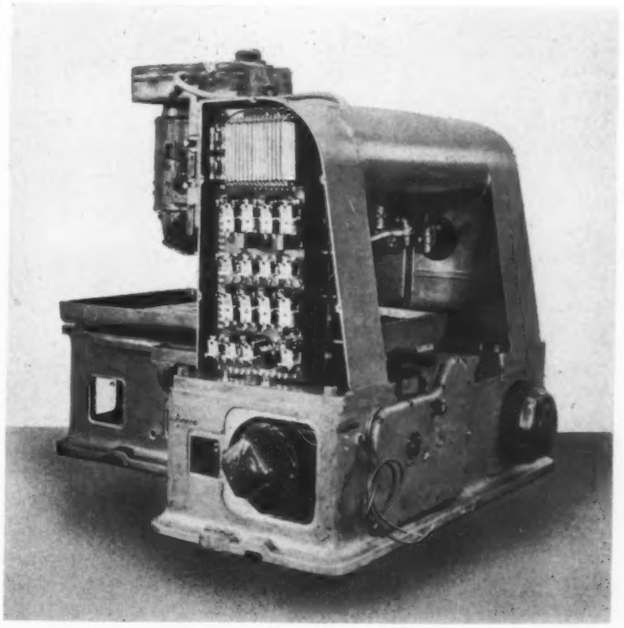
By Harold B. Veith

Fig. 1—Built-in electrical controls contribute effectively to balanced design in addition to convenience of operation

COMPARE the machine of today with its counterpart of a few years ago! Observe how designers have utilized the "built-in" idea to remove the unsightly "humps and hollows" that characterized yesterday's models! This new trend, particularly as it pertains to electrical controls, has done more than merely improve appearance. Built-in devices also make it possible to conserve space, increase operating efficiency and refine machines generally. While a transition has been taking place in the design of all machines, perhaps the machine tool industry can claim the honor of being somewhat more aggressive than others. That may be due to the fact that this type of machine is inherently a precision unit by means of which other machines are produced. In any event, the designers of other classes of machinery can profit from what has been accomplished in metal cutting equipment from the standpoint of the built-in electrical control.

The modern trend toward embodying these mechanisms in the machine as an integral part is disclosed by *Fig.* 1, a surface grinder which shows how effectively this procedure blends with other steps that have been taken to attain balance and a smooth flow of lines. Building eye appeal into machines is imperative . . . . it is becoming more and more essential from a sales viewpoint. Numerous articles in past issues of MACHINE DESIGN covering this phase of engineering have stressed its importance. One of the major points in designing for built-in electrical controls is careful selection of the location for starters, operating buttons, limit switches and other accessories from the standpoint of the wiring. This must be concealed if possible or at least made inconspicuous, not forgetting that the wires, however, must be accessible in case of trouble. How this is accomplished in a milling machine can be seen in *Fig.* 2. The control panel for the four motors em-

Fig. 2—Panel controlling all four motors of milling machine fits into one side of housing



ployed is designed to fit into one side of the housing, cast covers being used to close the port. By means of cored holes in the bottom of the housing, which line up with corresponding holes in the base, the wires supplying power to the motors in the base compartment and to the push-button station at the other side of the machine, are kept under cover. At the operator's position, *Fig.* 5, there are four field rheostats and a starter for a small pump motor, all built in with no wiring in view—a distinct aid to appearance.

Need for conservation of space is a factor that largely has been instrumental in bringing about a new type of control. Now it is advantageous to have the controller as small as possible so that it may be fitted most readily into available locations. In this the various control manufacturers have worked closely with designers. When the control is to be housed in the body of the machine or mounted on supports that are part of the unit, the designer should consider space conditions and select his control in the early stages of layout. When this is done a desirable location can be arranged from the operator's standpoint, at the same time providing for wiring that can be inspected readily.

For a large majority of uses there are available controls designed so that equipment normally supplied in enclosing cases can be obtained with "deadback" construction, permitting them to be wired and mounted in machines without providing spacers for electrical clearance. Controllers on the market with this construction cover a wide range of sizes in both nonreversing and reversing across-the-line and reduced voltage types.

Starters with parts completely insulated from the plate or base, the overload relays being mounted as an integral part of the main mechanism, are extremely flexible in building up controls. Modern arc hoods with individual arcing chambers also are new features of starters that make for space saving. This safety measure snuffs out contact arcs when the switch is opened under load and is an important adjunct in reducing the size of today's starters.

It may be well to bring attention to the need for ventilation of a controller, especially if there are thermal overload relays on the panel. This is necessitated because the tripping temperature of the relays will be affected by the temperature of the control compartment. Moreover, the electrical devices should be mounted where they will not be subjected to vibration, since such a condition may cause the nuts and terminal screws to loosen and if severe vibration is encountered, light or delicately adjusted relays may be caused to operate without being energized. Finally, in order to assure satisfactory operation, the controller should be adequately protected from dust and flying chips.

Controls Should Be Concentrated

Location also takes on another important aspect, which in this case applies to the push buttons. Here centralization of built-in controls comes into prominence. Efficiency of operators depends largely on the consideration designers have given them in developing their machines. When the controls are concentrated on one panel within easy reach of the operator as depicted in

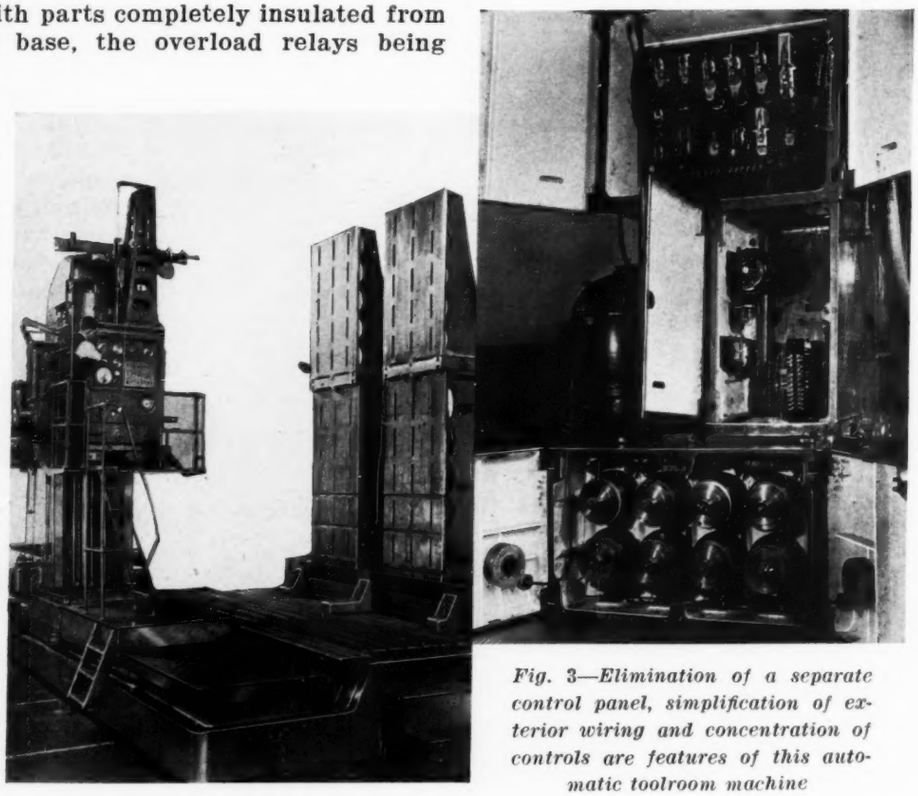


Fig. 3—Elimination of a separate control panel, simplification of exterior wiring and concentration of controls are features of this automatic toolroom machine

Fig. 6, the designer can rest assured he has done his part.

In this instance of a master control panel on a lathe, complete electrical supervision for both set-up and full automatic operation of the machine is provided at this central point. The main starter button starts the feeds to both front and rear carriage, in addition to starting the spindle and the coolant pump. One reverse button will reverse both carriages at any point in the operating cycle, the carriages returning quickly to the original starting position. Another button controls the front carriage and provides inching movement to the front tool slide and carriage for convenience in setting-up. And still another button gives inching movement to the rear tool slide for set-up purposes.

A red light at the top of the panel indicates when current is on in the feeding mechanism. It lights at the end of each cycle and is a signal that the machine is ready for reloading. The voltmeter indicates the voltage on all the precision contactor switches. This partial explanation of the operating characteristics of the lathe control arrangement is ample evidence of the value in centralizing them on the machine, particularly from the operator's standpoint.

When size of the machine reaches unusual proportions the design and position of the controls gains even more importance. It goes without saying that unless this feature is carefully worked out one man would be incapable of operating such a unit as the automatic toolroom machine, *Fig.* 3. As designed, the operator need never leave his platform during the machining procedure. He always can remain in a position where his work will be under easy observation. Three knobs on the upper lever of the control panel permit him to secure the complete range of spindle motor speeds and of horizontal, vertical and transverse feed and rapid traverse. Also within easy reach are the shift levers on the spindle drive gearbox—more evidence of electrical and mechanical controls being co-ordinated in respect to position. The inset illustration shows how the motor starters and other electrical devices have been grouped.

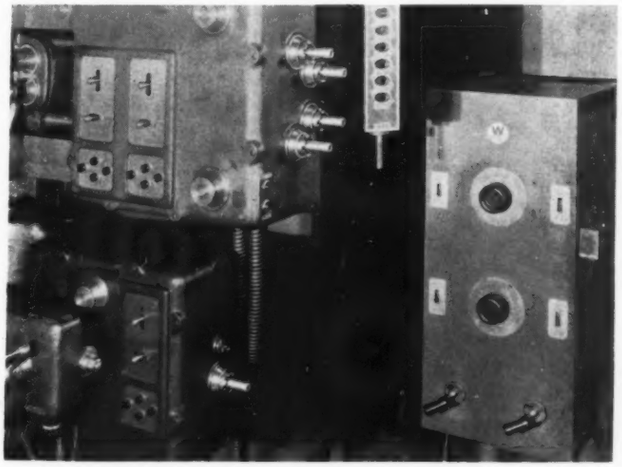


Fig. 4—Operator's control station from which all functions of openside planer are directed. Note pendant push button station

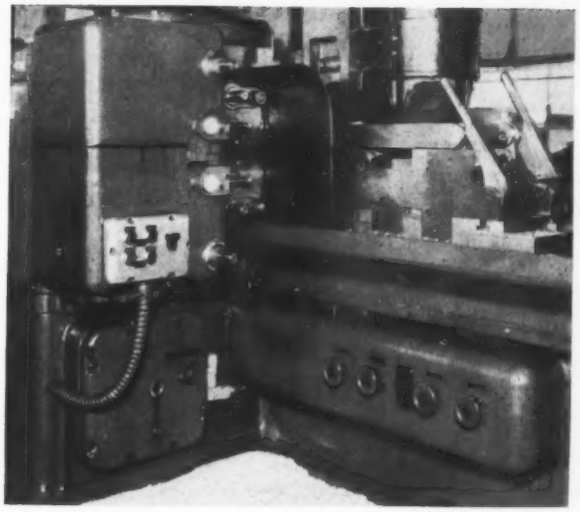


Fig. 5—Above—Built-in control devices permit clean design with no wiring in view

Fig. 6—Below—Master control panel on lathe embodies devices by which complete operations are governed electrically

Hundred Per Cent Electrification

Another large machine, a sixty-inch openside planer, stands as a striking example of the most extensive electrification of a machine tool to date. Complete control of the normal machining operations are centralized in a pendant station, *Fig.* 4. The operator is not required to manipulate any other levers or switches after the job is set-up.

The main drive control is the full magnetic type and provides overload and low voltage pro-

(*Concluded on Page* 111)

Hydraulic Controls Simplify Design, Aid Flexibility

By William A. Hart
Chief Engineer, Colonial Broach Co.

MOVING parts create wear; wear necessitates maintenance; wear also may introduce inaccuracies; maintenance and inaccuracies bring user dissatisfaction; user dissatisfaction influences future sales. It is like the old saw about the lack of a horseshoe nail. Careful design, of course, will reduce wear to a minimum, but it is obvious that an excellent way in which to eliminate much of the wear is to eliminate many of the moving parts.

When an engineer not only cuts down the number of moving parts, but also achieves increased utility, greater flexibility and simplified operation, his methods deserve attention. For example, in the design of surface broaching machines built by Colonial Broach Co., moving parts exclusive of the slide and fixture in the single ram type, the simplest type in the line, have been reduced to three—the ram, the motor and the pump. This arrangement was made possible only by the employment of hydraulic principles in the operation of the broach. With the use of hydraulic operating mechanisms an infinitely variable speed for the tool is obtainable.

In the broaching machines to be discussed in the following, both single and double ram machines are covered. These machines are fabricated from a combination of electrically welded steel plates and steel castings. They are of three-piece construction, comprising the base, the column and the table. The columns are lined with hardened and ground steel ways in which the broach ram slides. This main ram is made of alloy cast iron, and is bored and honed accurately, producing the cylinder. Hydraulic pumps and controls used in the machine are designed and built by Vickers, Inc.

The hydraulic system in the single ram type, *Fig.* 2, is arranged to operate the ram at a high cutting speed and a fast return. The circuit is very simple as shown in *Fig.* 1. While this diagram shows a manually operated system, it is possible to arrange this circuit for semi-automatic or full automatic operation. To produce a steady, even stroke on the broaching tool, a back pressure is maintained during the cutting stroke.

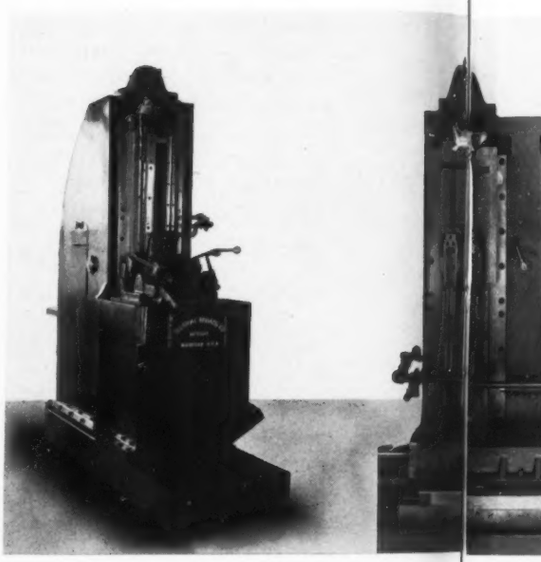


Fig. 2—Single ram type broach has a high cutting speed and fast return

Fig. port

Ram speed ranges from 0 to 45 feet per minute, and is determined by the setting of the lever on the feed control valve. When the speed is reduced from the maximum, oil not necessary for operation of the ram flows through the control valve and returns to the tank at the pressure required to actuate the broach. This control results in considerable power saving, keeping the input always at a minimum. The return stroke is permanently set at 90 feet and utilizes the full delivery of the pump.

In the dual-ram model shown in *Fig.* 4, actuating means for the table are incorporated in the system. The hydraulic circuit used is shown in *Fig.* 6, and is comprised completely of standard hydraulic units. Machines can be arranged for any tonnage or stroke, incorporating the

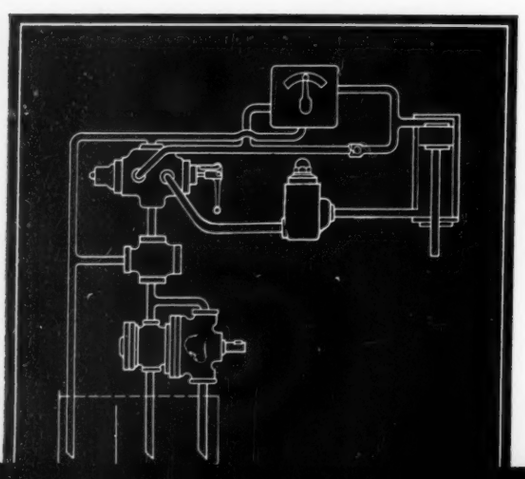


Fig. 1—It is possible to arrange circuit for semi-automatic or full automatic operation

full automatic principle, as in the machine under discussion.

The hydraulic pump actuates the ram which is interlocked in a 1000 pound lock system with suitable valving. When the control valve is shifted to the operating position, the four-way valve gives a regular reversal of flow to provide an alternate reciprocating motion to the rams. While one set of tools is cutting, the other is returning to the top of its slide. This sequence and operation of the valves is controlled by dogs on the rams and may be varied to satisfy requirements. Brazed steel tubing carries the hydraulic fluid.

Interlocked with the ram operating valves are the valves for operating the table. With this arrangement the table is shifted from side to side, loading being possible on the side of the machine where the tools are returning to the top of the slide. Again dogs on the table control the valves and the sequence of operations. Also in the circuit is an emergency return valve. This unit practically short-circuits the operations, permitting the reversal of the tool at any time. It is particularly useful during the setting up of the machine, but also can be used should the operator discover any emergency which might wreck the tools if the operation were continued. A further safety factor is provided by the treadle bar which can be seen just under the table in *Fig.* 4. A kick against this treadle bar will stop the machine instantly.

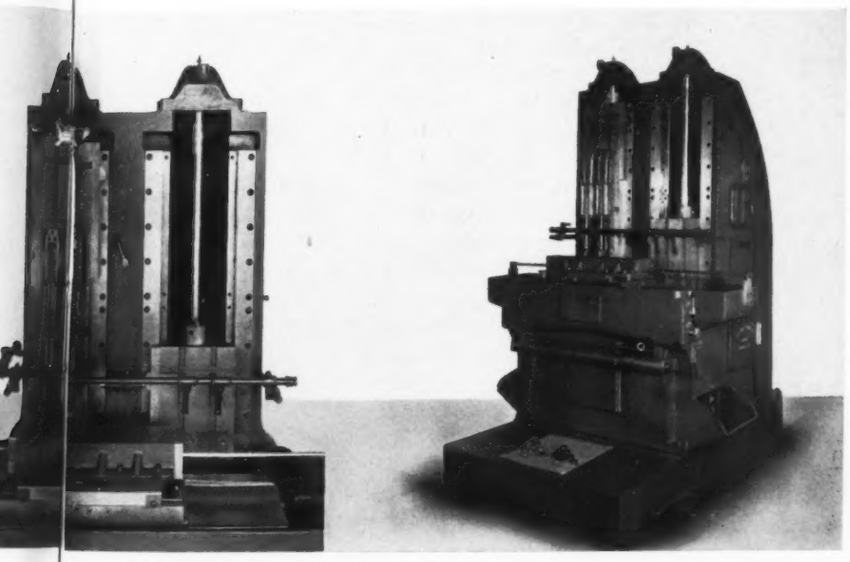


Fig. 3—*(Center)—Large bars with corners planed out are used to support slides.* *Fig.* 4—*(Right)—Reciprocating table simplifies operation*

The hydraulic pumps and associated controls provide the actuating means for the broach, but the determination of the actuating means and of the circuit does not conclude the design steps necessary. Application of the power to the tool must be made in the most efficient manner possible. In the design of these machines, it was decided to arrange the cylinder unit, *Fig.* 5, so that the part which carried the broach would travel, and the piston would be stationary. To simplify the design further, a special oil control manifold for each ram, *Fig.* 7, was designed to be placed on top of the machine. These manifolds can also be seen in *Fig.* 3, and are directly connected to the rams.

Oil passes from the manifold through the inner and outer pipes in the specially constructed piston rod to the cylinder. After actuating the cylinder it flows back out through the center of the piston, through the manifold, then into the tank. This method of regulating oil flow eliminates the necessity of a stuffing box on one end of the cylinder. Ports and cored passages in the cast steel manifold, *Fig.* 7, control the travel of the oil.

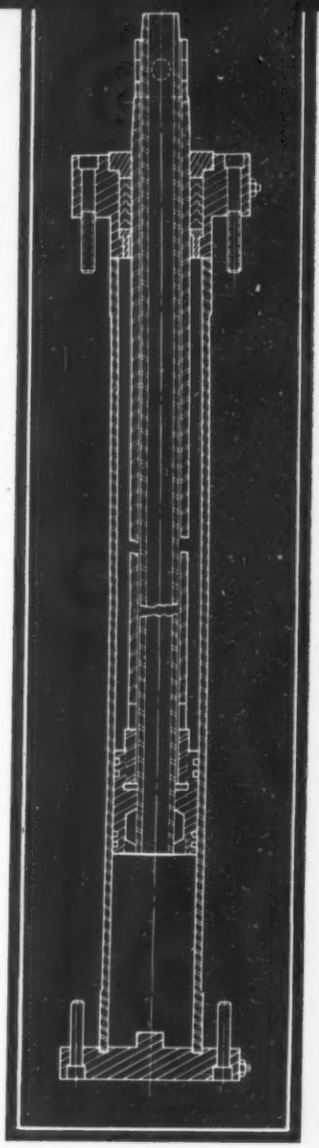


Fig. 5—*Portion of cylinder which carries the ram travels, while piston is stationary*

A further requirement of hydraulically operated machines is the provision of an adequate supply of oil. In the case of this broaching machine, a large capacity oil tank has been built into the base. This tank is large to insure a cool running circuit at all times, and to be certain that the complete system is always free from air the oil passes through a baffle system in the tank. A pressure gage in the circuit gives the exact broaching pressure, while gages on the side of the tank indicate the exact oil level.

Lubrication System Built In

With the one central motor controlling all operations of the broach, it was natural that the lubrication system be incorporated so that the lubricant would be distributed under the impetus of the same motor. A plunger pump connected with a distribution valve receives its oil from the hydraulic system, and delivers a measured quantity to all parts of the machine at each cycle.

In addition to the pumps already mentioned, there is another pump in the machine, mounted integral with a separate motor, for supplying coolant to the tools. This motor-pump is placed inside of the base, out of the way of trucks

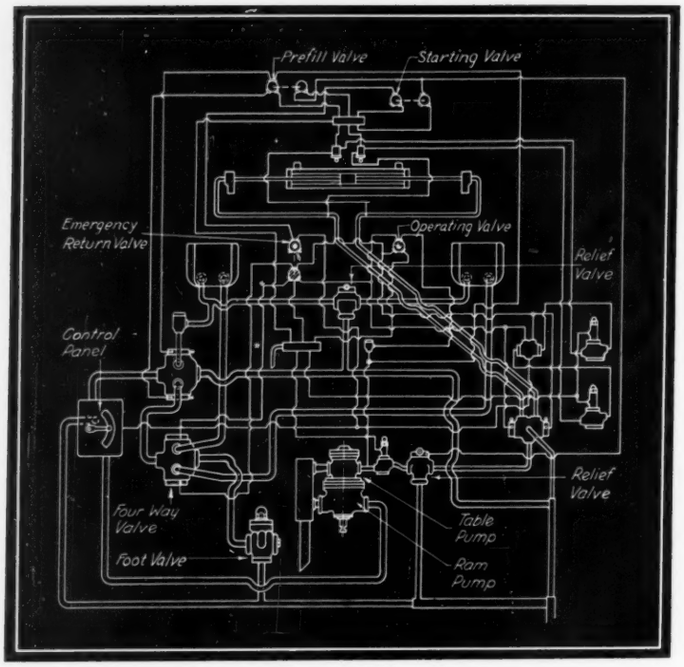


Fig. 7—Manifolds direct the travel of hydraulic fluid through ports and cored passages

with a corner planed out would produce a more accurately true mounting for the slides than any other method of manufacture.

The slides themselves are of alloy cast iron and have a V-gib construction, adapted to this broaching machine because of the greater bearing surface provided. Thus the slide, firmly backed up, maintains the cutting tools in perfect alignment.

In the design of a broaching machine, the tool travels in a straight path, so the direction of forces is readily ascertainable. As the machine is used for continuous production, roughing and finishing in one pass of the broach, it is necessary that the frame be extremely rugged, thus eliminating the possibility of chatter and vibration. The simplified means of changing tools, which are mounted on holders bolted and keyed to the ram slide, aids in achieving high production. The many teeth increase the life of the tool, reducing the cost per piece produced.

All of these factors are inseparably connected with the use of hydraulics as an actuating means. By the use of hydraulics a quick acceleration and deceleration is obtainable, exact control of cycle is permitted and, as previously emphasized, the number of moving parts is greatly reduced.

In conclusion, the writer feels that surface broaching is still in the stage of development, and that this method of machining will make great strides in the near future.

which might be passing alongside of the machine. Cutting fluid under pressure is washed over the tools to remove all chips. The coolant returns to a tank in the base through a special grill frame which catches the chips. A large opening in the side of the machine permits easy removal of these chips.

Having considered the method of overcoming the driving problem for this broaching machine, it might be well to discuss the overall design. Hydraulics, as mentioned, was chosen for the drive in order to obtain simplicity and a minimum of moving parts. Following this precept of simplicity, the machine is constructed of three main portions as described. Base and column are standard for each unit in the line, but the table can be varied as desired.

All of these machine units, except the cylinder casting and the manifold casting, are fabricated by electric welding from hot rolled plates. This design was adopted because of the need for a rigid support for the tools. Ribs on the larger surfaces are employed to eliminate drumming and all weldings are annealed three times for stress relief. The corner posts in which are mounted the ways, are six by six bars with a corner planed out in the form of a right-angle to an L-shaped section. This method of fabrication was chosen after trial had demonstrated that the use of a solid section

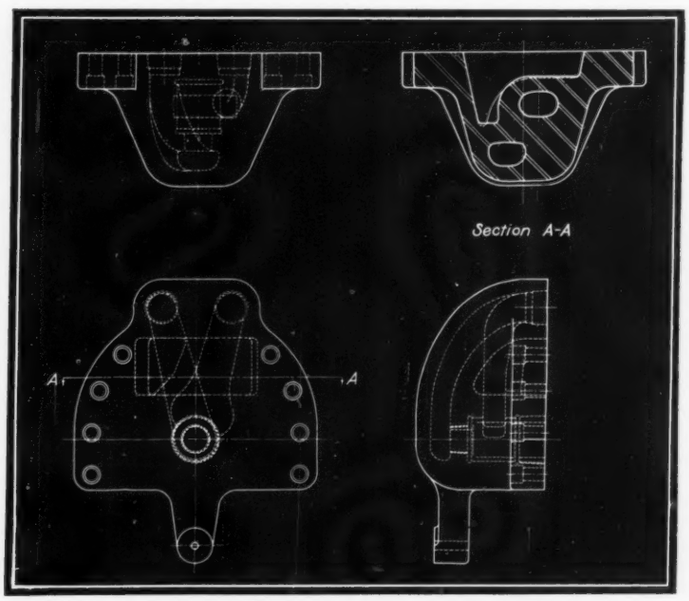


Fig. 6—Hydraulic pumps and suitable valving govern operation of two rams and reciprocating table

PROGRESS IN MACHINE TOOLS

A

Brief Dramatization

OF

PAST...PRESENT...FUTURE

of our Basic Machine Industry

MACHINE TOOLS

—Then and Now!

By GUY HUBBARD
Machine Tool Consultant

For hundreds of years there have been instances of men with brilliant mechanical and engineering imaginations, whose visions in many cases would have advanced civilization greatly if they could have been carried out in practical form at the time of their conception. Only through the medium of machine tools could those engineering visions have been translated into working mechanisms, and so the world had to forego the benefits of the higher forms of mechanization until machine tools worthy of the name became available. That was not much more than a century ago. Therefore, as time is measured in the history of the world, we still are not far from the pioneer machine tool builders and their creations, even though the industry itself has traveled far in terms of technical progress.

The machine tool industry in America was born of a desire to manufacture metal products interchangeably. Interchangeable manufacturing was transplanted into the minds of American mechanics by Thomas Jefferson, who in 1785 picked up the rudiments of this epoch-making idea in France. Not only did he transplant the idea, but moreover he made vigorous efforts to make it take root—seeing it as he did as a vital link in the chain of national defence through its importance in the quantity production of high grade military firearms. The fact that Thomas Jefferson deserves great credit as an engineer has been lost sight of due to his political achievements as one of the founders of our Republic.

With no intention of overlooking the splendid work of Henry Maudslay and other pioneer machine tool builders in England, who unquestionably exerted a profound influence upon the form which American machine tools assumed, we will in this brief narrative turn directly to the work of Eli Whitney, the American. Whitney, popularly known as the inventor of the cotton gin, seems to have been the first American mechanic to grasp in a practical way the significance of Thomas Jefferson's suggestion as to the interchangeable manufacture of firearms. Under the patronage of Jefferson, Whitney was awarded in 1798 a United States Government contract for 15,000 stand of arms.

To carry out this contract under his "new principle of manufacturing" by the use of "machinery moved by water," Whitney had to start from the bottom, not only in the layout of his new plant in a suburb of New Haven, Connecticut, but more particularly in the case of every jig, fixture and machine with which it was equipped. It is to the everlasting credit of Thomas Jefferson and the officials of the War Department that with patient understanding they bore with Eli Whitney during the several difficult years of preparation through which he had to pass before being able to deliver his first lot of interchangeable guns. In no small measure it was due to the liberal attitude of these officials that by 1815 the interchangeable system of manufacture had taken firm root in the United States. It was from that root that the machine tool industry in this country has stemmed.

There is no record that Eli Whitney ever manufactured machine tools other than for his own use. His factory, which never was large or fitted up for heavy machinery production, always was kept so steadily busy on gun work that machinery manufacturing for the trade scarcely would have fitted into the picture. His claim to fame as the pioneer machine tool man in America rests upon his early and profound influence upon machine tool design—as for instance in the case of the milling machine.

To eliminate the slow method of surface shaping

as exemplified by hand filing in hardened jigs, Whitney in 1818 designed and built a rudimentary form of manufacturing milling machine with power feed to the table. Then this is what happened. A Whitney workman carried the idea to the shop of Silver & Gay in North Chelmsford, Massachusetts, where in the 1820's there was built a more highly developed milling machine in which were plainly embodied several of the Whitney design features. From the shop of Silver & Gay there went forth an apprentice by the name of Frederick W. Howe who in 1850 designed and built at the Robbins & Lawrence Co. at Windsor, Vermont, the first of those machines now known as Lincoln millers. Whitney features were, and still are embodied in these very useful machines, which eventually were built in great quantities by the Pratt & Whitney Co. of Hartford. Mr. Howe eventually became associated with Brown & Sharpe, being in fact the first president of the Brown & Sharpe Mfg. Co. Through him certain of the Whitney features appeared in the Brown & Sharpe milling machines, wherein—in common with other high grade modern milling machines—they still are apparent. If space permitted, many similar cases of persistence of design features might be cited, which proves the good design sense of the founders of the industry in America.

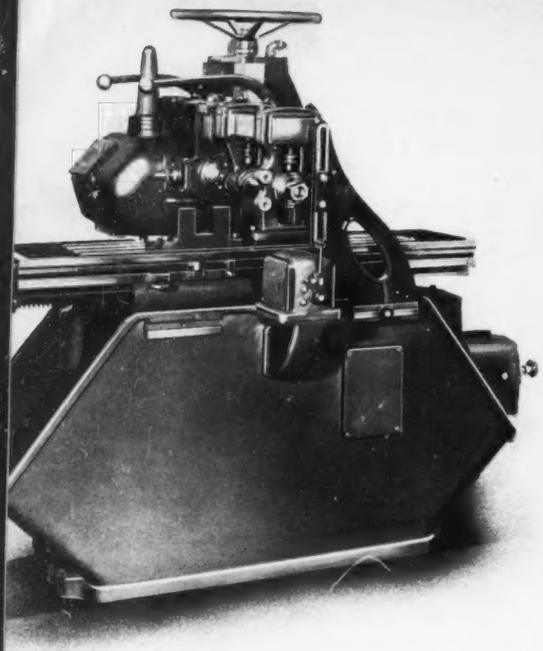
Although the manufacture of machine tools did not become to any extent a distinct industry until after the Civil War, it is a fact that as early as 1830 some of the more progressive builders of firearms, textile machinery, water wheels and engines, who developed successful machine tools for their own use, discovered a profitable side line in the manufacture of duplicates of these tools for others. In some of these instances the machine tool line eventually became the tail that wagged the dog, as in the case of the Jones & Lamson Machine Co. whose predecessors manufactured pumps and firearms as far back as 1828 on equipment of their own design. All this will explain why, in tracing out the actual industrial descent lines from Eli Whitney and the other pioneers to machine tool builders of the present day, some relationships are found to be very direct while other lines are so tangled into various interchangeable manufacturing projects as to be impossible to trace clearly.

The earliest American machine tools were built along severely practical lines. The larger ones generally had heavy timber frames which in rugged strength and lack of beauty had a great deal in common with the frame of an old-fashioned barn. When these were redesigned in cast iron, however, a decorative riot often resulted, involving a wholly illogical mixture of claw feet, scroll work, ogee curves, and fluted columns —sometimes in the Ionic manner and sometimes Corinthian. It came about in this manner. Drawings—other than rough sketches on boards—seldom were used in those early days. Machines were evolved directly "out of the head" of the inventor and were embodied in the form of wooden models on which the cut and try method could be and was freely practiced. These wooden models oftentimes were carved out by cabinet makers who likewise acted as patternmakers when the time came to convert the design into iron. More or less out of force of habit, these "cabinet-patternmakers" worked into the patterns the technique both of period furniture and of architectural trim.

In a few cases early manufacturers of firearms, clocks and sewing machines subdivided their mass production by the use of specialized or limited purpose equipment. Ordinarily, however, the typical machine shop of fifty years ago was equipped only with such general purpose machine tools as engine lathes, planers, a number of plain milling machines and a few universals, some simple upright drilling machines, possibly a horizontal boring machine and a vertical boring mill, and certainly a grindstone. With such equipment plus a large measure of ingenuity on the part of the machinists (all of whom had served apprenticeships) the manufacture of anything from a thread spooler to a mine hoist would be undertaken.

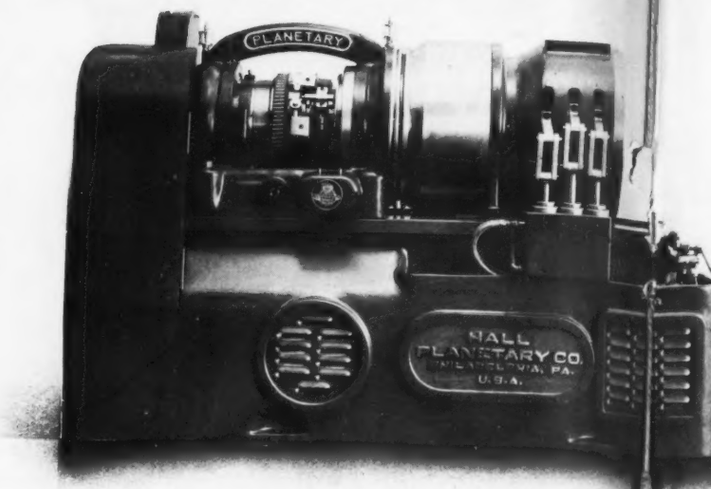
Subsequent to that time the common or general purpose machine tools began to be subdivided more and more into groups of limited purpose machines. These have some of the characteristics of the parent machines but they are more exactly suited to handle certain definite operations. While this subdivision of machine tools became apparent upon the rise of sewing machine and bicycle manufacture, it by no means became common until mass production of motor vehicles began to be highly competitive about twenty-five years ago. It is significant that those machine tool builders who were quick to realize the importance of the automotive industry as a market for tools and who modified and improved their designs accordingly, are the ones who either have stayed in the foreground or who have forged to the front since the turn of the century. They are the ones who were quick to take advantage of the possibilities of high speed steel, of electric drive, of antifriction bearings, and more recently of the cemented carbide cutting materials, of hydraulic feed and electric control mechanisms, the latest alloys for machine parts, and they are the ones who have entirely discarded the last vestiges of rule of thumb methods in machine tool design.

In the products of these progressive companies the machine tools of the future—that is at least for the next five years—actually are with us today, and this is clear in the mind of the always forward-looking Mr. Harrison, author of the article commencing on page 62. No machine tool authority is better fitted than he to pick up this theme where I now leave it.

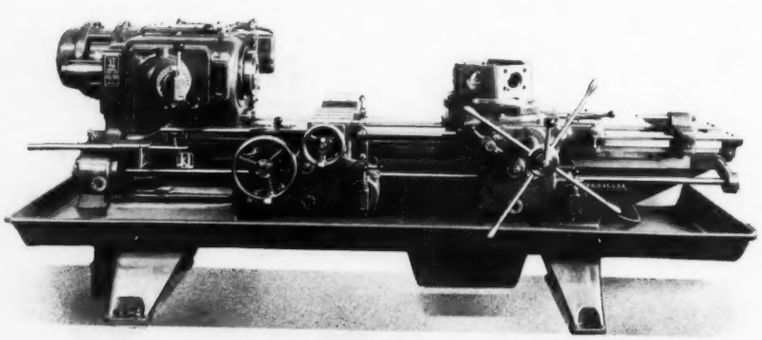


COMPLETE electrical control of the Sundstrand Electromil, left, is divided between the waterproof control box on the front of the machine, which is actuated by adjustable dogs on the table, and a panel in a compartment at the rear of the machine where all electrical connections are centralized. The panel is completely enclosed, yet may be withdrawn for inspection without disturbing any of the connections. Coolant is supplied by an independently motor-driven pump.

FOLLOWING a pyramid type of design, there is no right or left side of the Hall planetary, below. Directly below the head and gear box, which slides in like a bureau drawer, is the motor for driving the machine with ventilation covers on each side.



SINGLE lever speed and feed selectors with direct reading dials are employed on saddle type turret lathes, right. All variable speeds are obtained through sliding gears mounted on multiple splined shafts. Main spindle of the machine, built by Jones & Lamson, is of the flanged type with a taper pilot and is mounted on antifriction bearings set up under a predetermined load.



Design Fe
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A Pictorial Presentation o
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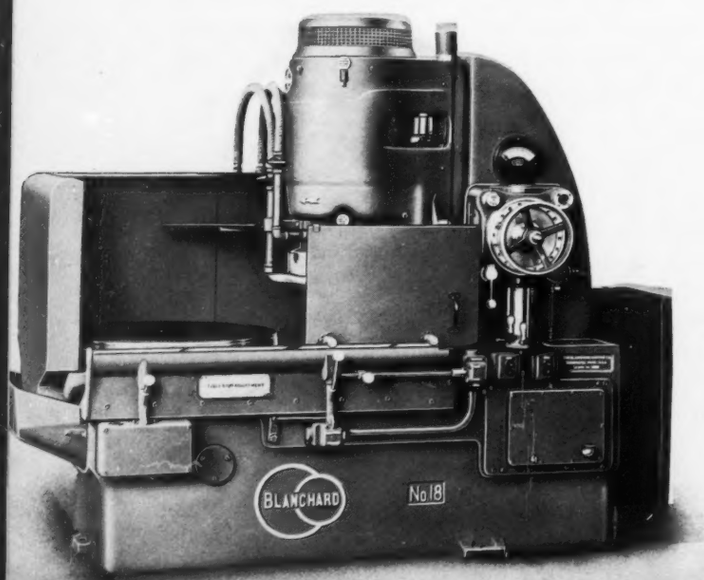
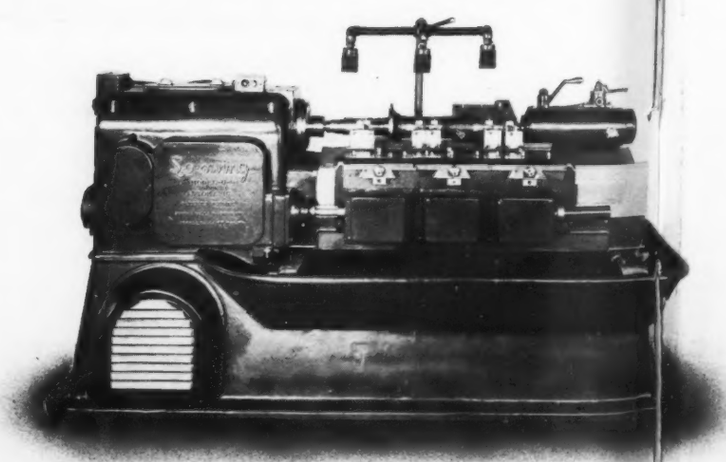
THE one-piece magnetic chuck on surface grinder built by Blanchard, below, is driven through a sliding gear box with six speeds from a direct-connected motor started and stopped by push-button control, eliminating the clutch.





POWER for the Seneca Falls Lo-Swing lathe, above, can be transmitted either through a belt or silent chain, in either case the drive being entirely enclosed. A force-feed pump floods all mechanisms with oil.

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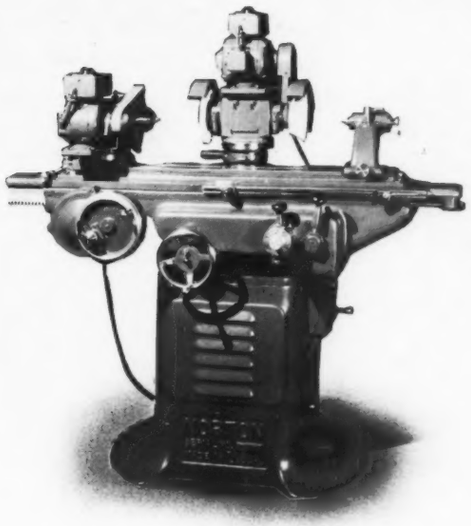
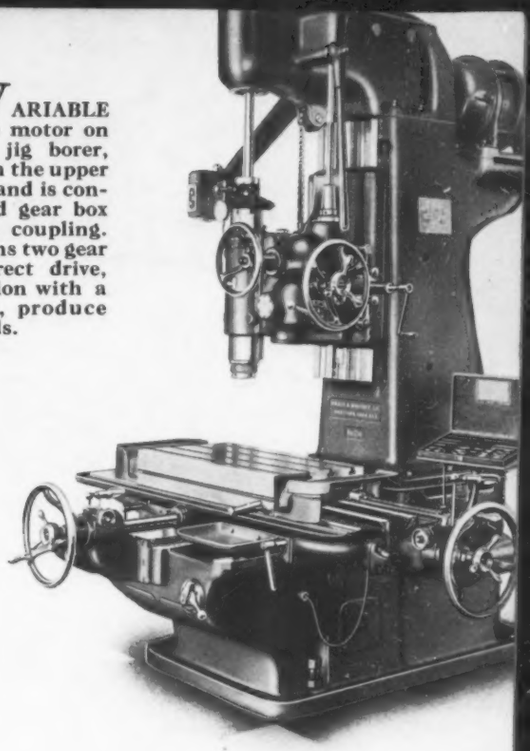
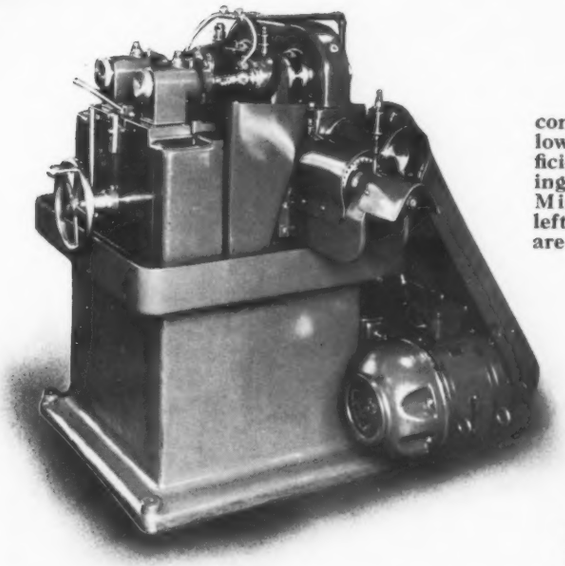
WHEEL spindle on Norton universal tool and cutter grinder, below, is driven by V-belt from a motor mounted directly above the wheel head.

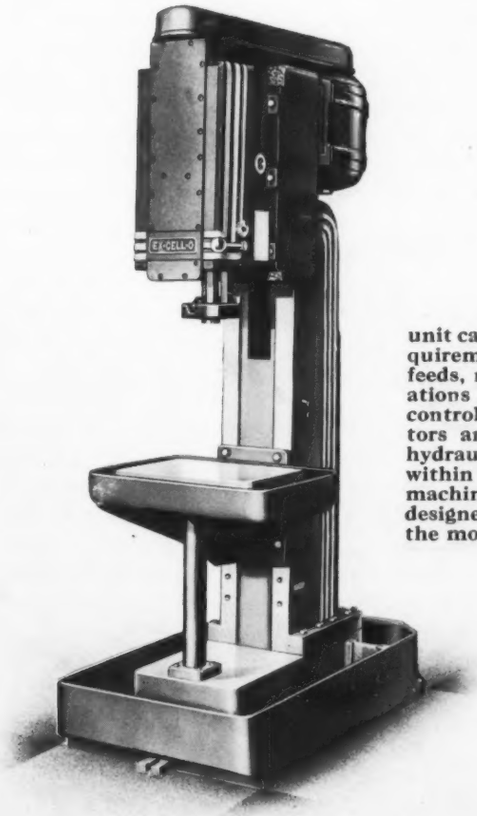


VARIABLE speed spindle drive motor on Pratt & Whitney jig borer, right, is mounted on the upper rear of the column and is connected to the speed gear box through a flexible coupling. The gear box contains two gear changes and a direct drive, which in combination with a four-speed motor, produce twelve spindle speeds.



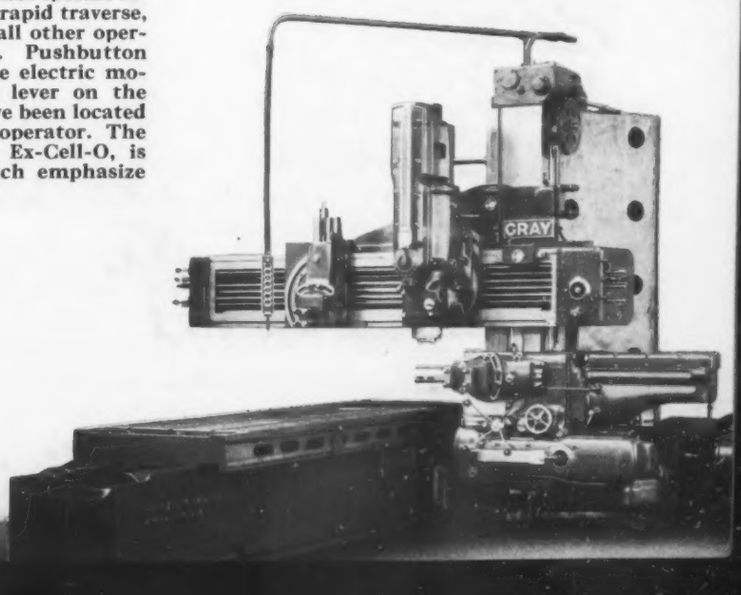


CONE AREA contact worm gears, with low unit pressures, high efficiency and high load carrying capacity are produced on Michigan Tool machines, left. In the machines there are two hobs per work piece.



HYDRAULIC power unit can be adjusted to meet specific requirements with stroke, rapid traverse, feeds, reverse, stop and all other operations easily controlled. Pushbutton control for operating the electric motors and the operating lever on the hydraulic power unit have been located within easy reach of the operator. The machine, left, built by Ex-Cell-O, is designed with lines which emphasize the motion of its parts.

A BALANCED helical gear drive is employed on the Gray milling planer, below. Milling heads are individual units, each driven by its own motor. The spindle runs in double-opposed preloaded antifriction precision bearings. Safety devices are provided for all of the feed and power traverse mechanism.



WHAT'S AHEAD In Machine Tools?

By R. E. W. HARRISON
Chief, Machinery Division
DEPARTMENT OF COMMERCE, WASHINGTON

Amidst the welter of thoughts harassing manufacturers during the six years of acute depression, it has seemed that even a single thought devoted to the importance of up-to-date manufacturing equipment has many times been sadly lacking. While all manufacturers unite in praising the forehanded thoughtfulness of Andrew Carnegie in his policy of re-equipping his steel mills during times of depression, I am afraid that most of us have regarded such a procedure as evidence of a higher degree of courage than that with which we are blessed, and let it go at that.

One of the outstanding characteristics of all business cycles has been a return to what might be termed machine tool consciousness at the beginning of the upswing, and indications are that this phenomenon is being repeated at the present time in no uncertain way. The August report of the National Machine Tool Builders' association reveals that a volume of business was booked during the month of July which represents the best amount of business recorded in any month since the depression.

Signs now are extremely healthy. With hourly wage rates in many cases up to or above 1929 levels, with the number of hours worked per week at lower levels than ever in the history of the country, with bitter memories of long periods of trading in the red, our manufacturers are now turning for help in that one direction which they know is the only road they can traverse toward comparative prosperity, i.e., the road which is known as manufacturing efficiency and which in turn is paved with machinery which will produce an accurate product in a minimum of time.

Looking back to the time when the first machine tools were put into operation we see indisputable evidence of the results of studies in the cutting and shaping of metals, and paralleling this we see a growth in the standards and comforts of living unmatched in the history of the world. That there is a distinct and unbreakable bond between these two developments is certain, and it is safe to say that the forthcoming machine tool exposition will see presented to industry at large, tools which will surpass in performance anything which hitherto has been thought of, and carry further the prospect of a still higher standard.

That old definition of a machine tool as a tool which removes metal with a cutting action has long since gone into the discard, as it imposed too much limitation on a technique which has progressed with extreme rapidity during the last ten years. Forging now is performed to such close limits that it rivals in many respects the machine shop operations of a few years ago. In fact, parts are produced with such accuracy that insofar as cylindrical surfaces are concerned, many go direct to the internal and external grinding machine without the previously necessary intermediate turning operation. This is temporarily unfortunate for the lathe makers, but above all it is progress. It means more and better grinding machines, and more important, a cheaper and better product.

Die casting operations on complicated parts produced to the closest limits of accuracy are now a regular commercial manufacturing procedure. Parts are produced with holes in position, plane surfaces in correct alignment and relationship with other surfaces, finish so smooth and accurate that machining in many cases is entirely unnecessary. and withal the nearest approach yet made to the finished job produced at one operation. This also is sad for the machine tool builders, in that drilling and tapping machines are not required and milling machines and grinders are

no longer necessary. However, we have a simpler article—probably a better and sounder one—but above all we have a cheaper product of higher quality. This is in the long run all that matters.

Coining presses now take pressed metal components and in some cases forgings and by a series, or perhaps only one coining operation, these components are produced to limits of accuracy hitherto regarded as entirely impracticable and attainable only by the closest machining methods. While it is true that the coining press has displaced a number of other machine tools the technique has been proved as having economic merit and it is, therefore, here to stay until a newer and better method is evolved.

In the sphere of materials we have many old and some new plastics, and the ease with which these newer materials can be molded under pressure to correct dimensions is a revelation to those manufacturers who have hitherto confined themselves to materials which are harder to work and which require numerous machining operations.

The pantograph gas torch-type metal cutting machine, the electric welding machine and the artist with the blow torch and templet have conspired to change the whole technique of fabrication to the point where the old style mechanic who whittled his components from the solid or from grossly oversize forgings is bewildered and at last realizes that he must do something about it if he is to keep up with the procession. To quote but one instance, tungsten and tantalum carbide cutting tools have made available results which have reduced the cost of products to the point where greatly expanded markets have opened up.

One of the most striking results of the new technique is evidenced in the modern engineering department and drafting room. This room is no longer a place of seclusion and retirement where a number of more or less bald-headed men evolve designs without an adequate appreciation of the machine shop facilities which are to be used to produce their designs in metal. Managerial executives today realize that the economic life or death of the products of their company is generated in the engineering department, and with this thought well in mind it is not uncommon today to see in the drafting rooms of the most progressive companies men who have expert knowledge of the new techniques.

For instance, as soon as a company realizes the possibilities of economies to be effected by the use of welded structures, the first place where the welding expert is employed is in the engineering department where he instructs and lectures to the personnel there so that they in turn may intelligently make use of the newer procedure.

One of the earliest examples of the use of highly trained specialists with knowledge of specialized machine shop processes was the employment of men who knew and appreciated the economic possibilities of the use of centerless grinding machines. Several of the most progressive automobile manufacturers took one or two experts in this line of endeavor and arranged that all drawings for cylindrical parts which might conceivably be ground on this type of machine be passed through the hands of these men and wherever possible designs modified so that the new technique might be applied.

Advent of the broaching machine during the last two years has completely revolutionized many machining operations, particularly in the mass production elements in the automobile industry. However, this change-over in work shop procedure was not accomplished without certain modifications in design, and as these modifications were all in the direction of simplicity they were economically sound and beneficial to both automobile manufacturer and customer alike. It was only the application of good common sense which dictated the desirability of having a man who knew the possibilities of broaching and broaching procedure stationed in the engineering department where he could advise the designers.

To many of us it has seemed that a long time has elapsed before the basic principles underlying the production economics of the automobile industry have filtered through into what might be termed the more general engineering shop. However, there are unmistakable signs that the present generation of designing engineers has realized, as never before, that the burden is on them to design for economical production. That cheap production is synonymous with accuracy within the maximum permissible tolerances is also accepted. Hence, the man who today places the limits of accuracy on the component drawings as they are passed down from the drawing office is regarded as a key engineer whose work vitally influences final costs.

Realization has grown up during the past years that the durability of accuracy is mainly dependent upon quality of finish; hence, in a number of the most up-to-date concerns manufacturing such high-grade and critically used products as airplane engines, it is customary for the engineer who specifies the tolerances to specify also the finishes inasmuch as the manufacturers realize that control over finish means control over length of satisfactory performance in the field, and this in turn determines the manufac-

turers' success or failure over a period of years.

All of the foregoing has had a profound effect on the machine tool builders, their problems, and their method of approach. Gone forever is the day when the machine tool builder sat in his office and thought out a machine tool, and then after manufacturing it, took his catalog and sold his product to the user who had to fit it in in the best way he could to meet his perhaps special requirements. Machine tools of today are the joint product of the user and the builder. The user with the urge on him to produce a cheaper and better product, and the builder with the urge to render a service which will make the user's objective commercially attainable. The problem of machine tool design starts with the user and finishes with the user and, radical as the thought may seem, the success of the whole procedure is determined largely by the attitude of the engineering department of the user company.

With the advent of the new technique, new and better inspection methods became imperative. Welded joints must be photographed and pulled. Machine finishes must be inspected, calibrated and evaluated. Accuracies within the tenth-of-a-thousandth must be readily and cheaply determined. Where lightness of structure is an essential, metallurgical considerations make it highly necessary that both chemical and physical tests be conducted far more frequently than was formerly the case. The use of automatic measuring and sizing devices in turn makes imperative the use of most sensitive mechanisms involving the use of antifriction bearings.

Indications of what is ahead in the way of future developments in the machine tool field are revealed by a critical analysis of all the elements which now go to make up the total time involved in the production of any one mass production article. Having regard to the fact that any machine tool is being used economically only during the time when the cutting or shaping tool is actually in working contact with the job we immediately come up against the two major subdivisions of productive, and idle or non-cutting time.

Such analyses can frequently be made with considerable profit by manufacturers engaged in other than mass production operation, as careful observation will reveal, as one walks through the average machine shop, that it is seldom more than 40 per cent of the machines are actually cutting metal at any one time. Close studies of the subject show that the average machine tool employed in the jobbing shop is seldom in actual metal cutting operation for more than 30 per cent of the available hours throughout the year. This would seem to indicate that the attack on idle or non-productive time has not been carried far enough. Trying to forecast with the best perspective we have available, we may expect in regard to all machine tools an improvement in work-handling facilities, servicing facilities and the elimination of all such chores as daily lubrication, the removal of chips and the cleaning of the machine.

Limitations on metal cutting capacity are chiefly matters of friction which generate heat which in turn distorts the work and sometimes destroys the cutting element, the removal of the chips or surplus metal away from the scene of the operation, plus the whole problem of rigidity and freedom from vibration, the answer to which has not yet been arrived at in respect to many basic tools.

Hence, looking ahead we may expect to see still heavier and more powerful tools with air blast and coolant facilities so provided that limitations imposed by heat and friction will be removed. This in turn means the use of coolant volume in such a way that it may involve the total enclosure or submergence of the cutting operation, the use of motive power two or possibly four times as great as that which is now applied and last, but not least, the provision of automatic chip disposal facilities which will remove once and for all this hitherto serious limitation.

Too little has been done so far in the way of joining up the functions of conveyor and fixture elements. An initial attempt has already been made and sufficient success obtained to serve clearly as a sign post to where we are heading. It is safe to say that the mass production scheme of the future envisages the use of a conveyor which will be nothing less than a series of jigs coupled together and indexed from machine element to machine element, the operations on the machine being automatically timed.

Evidences are available and unmistakable that at last the eternal triangle of design brains—the user, the machine tool builder and the electrical engineer—are getting together, and as a result of this we may look forward to a far more adequate use of the facilities for efficient control which the electrical industry can make available. When we consider the crudities of the electrical apparatus applied to most machine tools alongside the finished electrical applications on, say, the modern domestic refrigerator, we gain some idea of what we may look for in the way of automatic control. Selenium cells, thyratron tubes, hydroelectric transmissions, and perhaps television whereby an operator observes cutting tool action at a number of remote points are all possibilities for which the need is apparent.

If ten or fifteen years ago an automobile designer could have been presented with the specifications of the present day radio-equipped, air conditioned car, he would have declared the specifier crazy.

Perhaps the latter will be the writer's fate!

MACHINE DESIGN

Machine Tool Issue Commemorates Our Sixth Anniversary

NOT only does this issue of MACHINE DESIGN mark the sixth anniversary of the journal—it represents the largest issue, both editorially and from the standpoint of advertising, thus far published. Since the low point reached, in common with other technical journals and publications generally, around the summer of 1933 it has been increasing gradually in size. The current unusual advance, however, must be credited primarily to the fact that the interest of chief engineers and designers at this time is focused on machine tool design in view of the outstanding exposition to be held this month. It was to satisfy that interest that this issue was conceived.

Changes will be noted throughout the book, many of which will continue in subsequent issues. Here again the attempt is being made to meet the reader. The journal unquestionably has been improved—but to what extent is not for us to say. There are basic reasons for all the changes incorporated—yet additional comments regarding them, critical or favorable, would be welcome. Only by the constant gathering of such data from readers can MACHINE DESIGN expect to remain true to the objectives under which it was established.

That it anticipates maintaining its present enviable position is evidenced by its increase in staff, by its broadening of outlook and contacts, and by its even more complete utilization of all its forces. There will be more anniversary numbers, more changes. But MACHINE DESIGN always will keep as its primary consideration its function as "The professional journal of chief engineers and designers."

Looking Ahead!

THAT the machine tool is again coming into its own is amply proved by the available figures on production and sales of this type of machine. Increase in production during the past few months puts the industry into the high mark reached in 1926, the year considered for statistical purposes as being normal. And the present peak has been reached even prior to the Machine Tool show, rather than after all the new models have been examined and discussed.

What does this portend? Obviously, if more machine tools are being ordered, more machinery of other types is being produced. And more machinery of other types means more manufactured articles. Figure it as one may, there's a new era coming. Chief engineers and designers who have remained loyal to their profession may well have much to congratulate themselves upon in the near future—for their services probably will be sought just as avidly as the proverbial dollar during the past depression!

Professional Viewpoints

MACHINE DESIGN WELCOMES LETTERS SUITABLE FOR PUBLICATION

Is Our Patent System Weak?

To the Editor:

HAVING recently completed a series of ten articles upon the subject of patent law in MACHINE DESIGN, I was naturally very much interested in R. A. Perrett's letter printed under this heading in the Professional Viewpoints section of your last issue. Aside from being very clearly stated his letter no doubt represents the point of view of quite a few of our American business men and inventors.

It is a very timely subject. The Patent System of the United States is the most prolific one in the world and it has now reached the point where practical suggestions as to revision and modification in certain phases are in order. Basically, the system is sound. Most of the changes which have been made from time to time related to procedural matters rather than to substantive matters.

It is true that the principle of *exclusive rights* may or may not mean very much, depending upon a large number of inter-related factors. There are some of these factors that enter into the value of a patent which have no bearing upon our patent system. Thus, an invention may be born before its time or it may lie in a non-commercial field. Then, too, the invention may reside in a very crowded and overworked art, giving little play for broad patent protection.

Should Proceed Carefully

The best way to obtain a good patent and cover up all the possibilities in which the invention may be made, is to proceed carefully and to do a good job as one goes along, at the same time maintaining a high degree of co-operation between the patent attorney and the engineering, sales and executive departments of the company.

It is the issuance of a large number of weak patents which has caused certain inventors to refrain from filing in the patent office. They attempt to protect their ideas by a record of invention. This gives practically no protection, unless followed up by the filing of a patent application within a reasonable length of time. To rely solely upon a record of invention is a dangerous practice.

Patent rights are no different from any other property rights. The statement in Mr. Perrett's letter to the effect that a patent does not automatically protect the inventor, because he must fight his case in the courts, is true of all our property rights, whether tangible or intangible. If we want redress against an invasion of our property, we must resort to our courts, unless we use violence. The suggestion that patent rights be made the property of the Government and be enforced by it, is not entirely a new one. The question is much broader than one may first anticipate. It eventually leads to the matter of Private Enterprise vs. Socialism. Logically, it should be noted that such public ownership of patents would destroy the private individual monopoly granted to inventors for which the patent laws were established. As to the enforcement of patent rights by the Government, this suggestion runs counter to our American tradition.

Will Have To be Explained

So long as human nature is involved, patent rights, as well as all other private rights, will be violated, and will have to be defined and explained by our courts. If a system were involved in which patent rights were enforced by the government, the degree of effective enforcement would depend to a large measure upon the whim and caprice of the enforcing officers. The cost of such a system to the taxpayer would be enormous. Politics would run rampant with fraudulent purposes. The system would lead to partiality by the enforcing bodies. It would no doubt prove impractical and fail by reason of the abuses which naturally would arise.

—GEORGE V. WOODLING,
Patent Attorney.

Lapping Unit Is Self-Contained

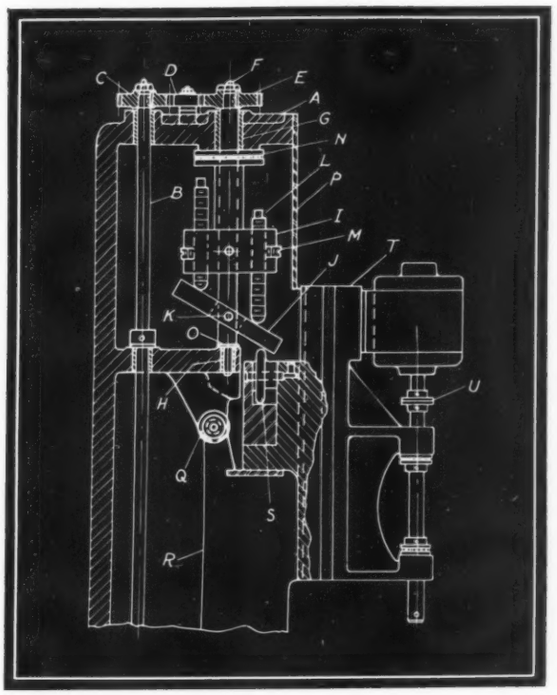
To the Editor:

IN THE accompanying illustration is shown a self-contained reciprocating unit which the writer designed for performing lapping and

diamond boring operations on piece parts with various diameters of bores and varying lengths. The lower portion of this unit is not shown, but it consisted of a flanged base below which projected a spiral bevel gear that meshed with a common driveshaft gear in the base of the machine. These driveshaft gears were keyed to the common driveshaft in such a way that they could be moved axially, thus allowing the units to be set to any center distance within the range of the machine.

Gears Are Pick-Off Type

The unit itself consisted of cast column *A* through which ran feed shaft *B*. To the end of this shaft was keyed gear *C* which meshed with gears *D* and *E*. It will be noted that all these gears are pick off gears. By this method it was possible to deliver to camshaft *F* any desired speed. Camshaft *F* had bearings at *G* and *H*. To this shaft was fastened adjusting screw housing *I*. In front of this housing cam plate *J* was pivotally fastened at *K*. Position of screws *L* determined the throw of the hardened steel cam plate *J* and screws *M* locked the cam adjusting screws in place.



Lapping and diamond boring operations are performed by self-contained unit

Ball Bearing Washer Takes Thrust

To take up the major thrust of the camshaft, the ball bearing end thrust washer was placed at *N*. In the opposite direction thrust was taken by the hardened thrust washer *O*. When adjustments of cam plate *J* were completed, guard plate *P* was fastened into place. At *Q* a counterweighted pulley was inserted, over which the counterweighted rope *R* was allowed to ride. Through this method the hardened cam roll *S* was always kept in contact with the cam plate. The remaining detail was the square gibbed slide *T* upon which was mounted the motor and the operating spindle, as shown. At *U* a flexible connection was made to eliminate as much as possible any transference of vibration from the motor to the spindle. It should be noted that by means of tilting the cam plate *J* and the pick off gears any desired throw at any given rate of advance within the range of the machine could be obtained.

Slide May Dwell

On a subsequent model the writer introduced a method for allowing the slide to dwell on the return stroke for unloading and loading purposes by the simple addition to one gib slide of an adjusting screw that contacted a fixed stop on the slide. The adjusting screw was then so set that the slide would hit the screw before reaching the high point of the cam plate and would be held until the opposite inclining surface would come into contact with the cam roll, when any further rotation of the cam plate would depress the slide again.

If this unit is turned into a horizontal position, and a revolving headstock added to the unit, boring, grinding and lapping operations of the horizontal type may be performed.

The uses for which this unit can be employed in individual and gang machining operations is limited only by the ingenuity of the person adapting it to the work required.

—J. A. HONEGGER,
New York.

Only One of Its Kind

To the Editor:

FOR ABOUT 9 years I was engaged as a machine designer in the United States, and it was, of course, in America that I made the acquaintance of your periodical. I certainly consider it the only one of its kind and to my knowledge it is really a worthwhile *designers'* magazine.

I am still engaged in the design of special machinery, chiefly in the wrapping paper printing and bag washing machine line, and I want to continue to receive your publication.

—ALEX WILSON,
Bristol, England.

MEN OF MACHINES

AS PRESIDENT of the machine tool congress to be in session during the exposition in Cleveland, C. R. Burt will have a prominent part in activities. Guidance of this important event falls into the able hands of a man who has proved his ability as a business executive.

Now president and general manager of Pratt & Whitney Co., Mr. Burt gained his early training at Brown & Sharpe. When the World war came he was placed in charge of equipping and operating four plants in Toronto and two in Buffalo. Personnel of these units included 12,000 operators producing shells, fuses and gun mounts. The record of the shops under his direction received recognition from British and United States governments.

CLAYTON R. BURT

• • •

THIS year's Campbell lecturer at the annual meeting of the American Society for Metals in Chicago will be Harry W. McQuaid, metallurgist, Republic Steel Corp. The engineer on whom this honor has been bestowed is co-originator of the McQuaid-Ehn grain size test.

Nationally known as an authority on steel for gears and case hardened parts, Mr. McQuaid has specialized in a study of the relation between steelmaking practice and the properties of steel after processing. His first position was with the United Piece Dye Works, in the engineering department.

Prior to joining Republic in 1933 he was associated with Timken-Detroit Axle Co., having been transferred there from Timken Roller Bearing Co. which he served as metallurgist.

HARRY W. MCQUAID

• • •

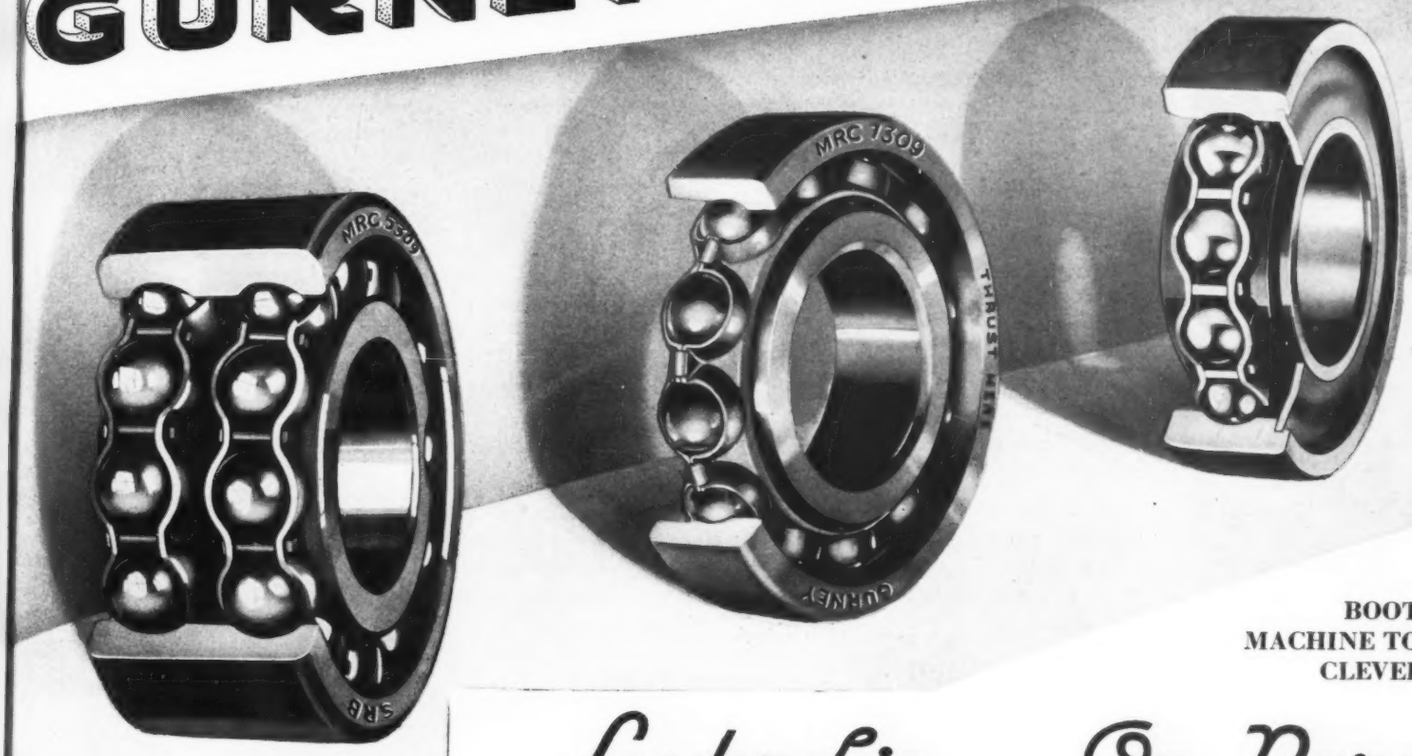
FIFTY years in the machine tool industry was celebrated recently by August H. Tuechter, president of the Cincinnati Bickford Tool Co., Cincinnati. His career is an illuminating story of an office boy who rose to president of a company. Born in Cincinnati in 1869, Mr. Tuechter went to work in 1885 when the death of his father made it necessary for him to become self supporting.

Obtaining a job with Henry Bickford, manufacturer of upright drills, the young man pursued his education at night school. He progressed, and on formation of the Bickford Drill & Tool Co. in 1893, became general manager and a partner in the business. Subsequently he entered into partnership with S. C. Schauer and together they formed the Cincinnati Machine Tool

AUGUST H. TUECHTER

M-R-C

GURNEY · SRB · STROM



BOOTH E-200
MACHINE TOOL SHOW
CLEVELAND

Leadership . . . On Parade

The Marlin-Rockwell exhibit at the National Machine Tool Show will include all recent ball bearing developments that have made possible the high speeds and precision workmanship of modern machine tools. Outstanding spindle applications will be shown featuring such bearings as the M-R-C Super-Precision operating at spindle speeds as high as 50,000 R.P.M. and the M-R-C Duplex that makes possible the enormous preloads necessary for maximum rigidity in heavy duty service. In fact, examples of many types of successful spindles will be available for close study and discussion. Be sure, therefore, to review this M-R-C Leadership line—on parade at Cleveland.

M-R-C Strom SRB GURNEY BALL BEARINGS

MARLIN-ROCKWELL CORPORATION

Executive Office - Jamestown, N. Y.

Factories: Jamestown - Plainville, Conn. - Chicago

M-R-C BALL BEARINGS

Co. In 1909 the Cincinnati Bickford Tool Co. was organized with Mr. Tuechter as president, in which capacity he since has continued.

Long a leading figure in Cincinnati's industrial activities, Mr. Tuechter holds many executive positions with other business enterprises. He is a past president of the National Machine Tool Builders' association and a member of the administrative council of the Metal Trades association. Also he is an associate member of the American Society of Mechanical Engineers.

♦ ♦ ♦

FRANK W. CURTIS, research engineer for Kearney & Trecker Corp. for the past six years, has resigned.

♦ ♦ ♦

L. H. MESKER has resigned as president of the Cleveland Planer Co. to engage in consulting engineering work.

♦ ♦ ♦

DAVID HILL, foundry and power transmission machinery engineer, recently was named service and development engineer for Beardsley & Piper Co.

♦ ♦ ♦

DR. H. L. HAZEN, Massachusetts Institute of Technology, has been awarded the Franklin institute Levy medal for his exceptional papers on the theory of remote control of apparatus by electrical devices.

♦ ♦ ♦

EDGAR S. BLOOM has been made president of Electrical Research Products Inc., New York. He entered the telephone industry in 1896 as a member of the engineering staff of the New York Telephone Co.

♦ ♦ ♦

FLOYD F. KISHLINE recently was appointed chief engineer of Graham-Paige Motors Corp., succeeding Louis Thoms, resigned. J. S. VOIGHT succeeds Mr. Kishline as assistant chief engineer.

♦ ♦ ♦

G. T. CHRISTOPHER has been appointed vice president in charge of manufacturing of Packard Motor Car Co. He succeeds R. F. ROBERTS, retired, to whom he has been an assistant for the past year.

♦ ♦ ♦

CLIFFORD E. BROOME, formerly with Wm. Ganschow Co., Chicago, and Gear & Forgings, Cleveland, has been appointed engineer in charge of the Lectrigear division of Ajax Flexible Coupling Co., Westfield, N. Y.

♦ ♦ ♦

HAROLD K. BARROWS, professor of hydraulic engineering, Massachusetts Institute of Technology, recently was elected first vice chairman of the Engineering Societies of New England.

♦ ♦ ♦

JOHN G. BARRY, senior vice president of General Electric Co., upon his recent retirement was elected to an honorary vice presidency. His career with G. E. began fifty years ago when he went direct from school into technical training as an apprentice and test man with the old Thomson-Houston Co. Other changes in the executive personnel of the apparatus engineering organization of General Electric have been anounced as follows: Commercial engineering activities of the transportation department will report to vice president H. L. Andrews; industrial commercial engineering will report to W. W. Miller, and central station commercial engineering to M. O. Troy.

♦ ♦ ♦

HOWARD C. COLMAN and BURT A. PETERSON were recipients of Longstreth medals of the Franklin institute for designing an "automatic spooler" that makes enormous length of thread available for use in cotton weaving without time lost to tie thread ends.

♦ ♦ ♦

WALTER P. CHRYSLER has relinquished the post of president of the Chrysler Corp. to K. T. KELLER, formerly vice president and general manager. Mr. Chrysler will continue as chairman of the board. FRED M. ZEDER (M. D., July, 1933), vice president in charge of engineering, has been appointed vice chairman of the board.

♦ ♦ ♦

H. S. VASSAR is the new president of the American Society for Testing Materials. He holds the position of laboratory engineer with Public Service Electric & Gas Co., Irvington, N. J. A. E. WHITE, newly elected A.S.T.M. vice president, is professor of metallurgical engineering, and director of the department of engineering research, University of Michigan.

♦ ♦ ♦

DR. IRVING LANGMUIR, associate director of the General Electric research laboratory at Schenectady, recently was elected to foreign membership in the Royal Society, England. Foreign membership, considered one of the highest honors that can be bestowed by British scientists on fellow workers in other countries, is limited to fifty persons throughout the world.

Obituaries

DR. ARTHUR DEHON LITTLE, aged 71, died Aug. 1 at Northeast Harbor, Maine, where he was spending the summer. He was chairman of the board of Arthur D. Little Inc., Cambridge, Mass., internationally known chemists and engineers, which he founded with the late Roger B. Griffin forty-nine years ago. A picture and biographical sketch of Dr. Little appeared on page 43 of the June issue of MACHINE DESIGN.

♦ ♦ ♦

WILLIAM H. POWELL, engineer in charge of d.c. design for Allis-Chalmers Mfg. Co., died recently. He was the inventor of the "frog-leg winding," a fellow of the American Institute of Electrical Engineers, and had been affiliated with many prominent companies.

♦ ♦ ♦

WILLIAM W. WYSOR, chief engineer, United Railways & Electric Co., Baltimore, died July 1. Nationally known transit engineer, he represented the American Electric Railway association as a member of the Standards council of the American Standards association from 1927 to 1931.

TOPICS

WHAT happens to engineers after they have completed their formal training? That moot question is being answered by a survey now in progress. After the American Engineering council had completed its brief analysis of the professional activities of 172,146 who listed themselves as engineers under the last census, many startling facts were revealed. The analysis opened up new lines of thought to such an extent that the United States bureau of labor statistics now is co-operating with the council and several national engineering societies in a profession-wide survey. Results are expected to be available before the year is out.

Listed in the preliminary survey are 78,813 civil engineers, 44,752 electricals, 40,409 mechanicals, 4738 mining and 3434 chemical engineers. Distribution of the five types shows rather unexpected facts. The major activity of those civil engineers listed is government service, 28.39 per cent, which with roads, building construction, and steam railroads account for 73.78 per cent. Telegraph and telephone, electrical machinery and electric power plants account for 66.34 per cent of the electrical engineers. Of the mechanical engineers listed, 23.2 per cent are in iron and steel production and machinery, 9.74 per cent in the automobile industry, 5.9 in electrical machinery, and the remainder scattered through 85 other industries with less than 5 per cent in any one. Of the total of 93 industries listed for all engineers, mechanical engineers are employed in 88.

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Don't Say, "The Metal Crystallized!"

An old and common fallacy comes into prominence again. It concerns so-called "crystallization" in metals under vibration, a condition that has been held responsible for many failures. Readers will perhaps recall the recent widely publicized report of a certain airplane endurance flight where "crystallization" in the metal was said to be feared by the aviators and given as their reason for landing.

The latest criticism of this belief concerning

PRECISION BEARINGS
in 108 distinct series

To the machinery world, NORMA-HOFFMANN offers the most complete and comprehensive line of anti-friction bearings in America—108 distinct series—a PRECISION Bearing for every load, speed and duty.

Many of these have been pioneered, or specially developed, by NORMA-HOFFMANN engineers to meet specific requirements as revealed by advancing methods in machine design, manufacture and operation.

In times past, engineers often had to adapt their designs to the comparatively few standard bearing types then available. Today—with the wide range of types and sizes afforded by the standard NORMA-HOFFMANN PRECISION line, such compromise is seldom necessary.

In the 108 PRECISION Series are included: ball, roller, needle and thrust bearings; open, closed, and angular contact bearings; radial and self-aligning types; single and double row types; felt-protected, shielded, snap ring and self-sealed types. The size range is from 1/8- to 21-inch bore, embracing both metric and inch sizes. PRECISION Ball and Roller Bearing Pillow Blocks are also available in an extensive range of sizes.

Write for the Catalog. Let our engineers work with yours.

"NORMA-HOFFMANN"
PRECISION BEARINGS
BALL. ROLLER AND THRUST

Booth A-401, National Machine Tool Exposition.

NORMA-HOFFMANN BEARINGS CORP'N., STAMFORD, CONN. U.S.A.

A-3127

"crystallization" comes from the National Bureau of Standards. The crystalline appearance of a broken piece of metal, it is pointed out, has been responsible for this erroneous belief. However, in reality these surfaces are merely a normal structure of the metal through which it has cracked, all metals in their solid state being aggregates of crystalline grains. In metals of the ductile type such as steel, the break is much more gradual and the small crystalline portion is the last part of the break.

• • •

The Worker Is Really a Capitalist

With an emphatic "No" C. L. Bardo, president of the National Association of Manufacturers, answered the question: "Is the American worker's high standard of living a myth?" To back up his argument, given in a recent radio address, he cited many facts and figures which provide conclusive evidence that the answer is correct. In his talk he declared that the accumulated savings of labor and the profits of industry from our earliest history, and their wise investment in new industries, coupled with the energy of the worker, the initiative of the individual, and the hope for profits, have built up the greatest industrial system in the world.

• • •

New Industries Consume Much Copper

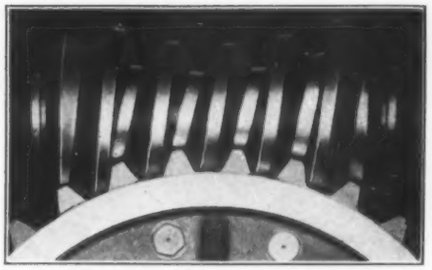
Some indication of the amount of engineering materials being consumed by two comparatively recent industries can be gained from the fact that a million pounds of copper and copper alloys are being used each week by the mechanical refrigeration and air conditioning industries. According to B. B. Caddle, secretary of the Copper and Brass Research association, the total tonnage for the year should exceed 50,000,000 pounds.

• • •

Want Lighter Engine, More Horsepower

An engine to be modern must be able to produce one horsepower for every two cubic inches of piston displacement, according to Joseph A. Anglada, prominent consulting engineer. While there are only a few in this category at the present time, he says, it is the yardstick by which engines are being measured in laboratories today. Engineers are reluctant to go up any further in the size and weight of their automobile power plants. Consequently, it is necessary to produce a lighter engine with more

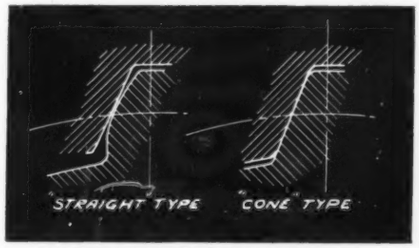
CONE AREA-CONTACT WORM GEARS NOW ON PRODUCTION BASIS



Now that complete and practical solutions of the cutting problems involved in the production of Cone Area-Contact Worm Gears have been reached, the amazing advantages of this ideal type of gear are available for wide application in industry.

The Cone Worm Gear, so named after its inventor, Samuel I. Cone, realizes in practice a principle long recognized as possessing important advantages, yet for many years impossible of production in quantity because no rational cutting method or practical tool equipment had been developed.

Continuous area contact over the full depth of the several meshing teeth has been achieved for the first time in the Cone Worm Gear, resulting in a long train of operating advantages.

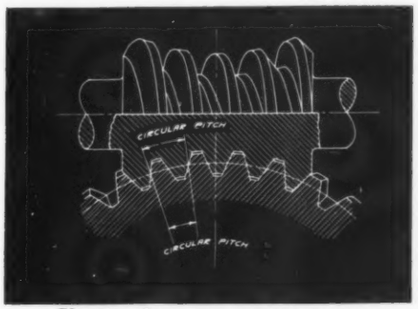


Line contact the full depth of teeth, as compared to point contact

Cone Worm Gears afford 30 times as much tooth area contact at a given time as the ordinary straight line type. The consequent distribution of pressure results in less wear, less heat generation, ideal lubrication, greater smoothness and silence, and a proved efficiency as high as 99.34%—the highest ever recorded.

Besides having the highest load-carrying capacity of any worm gear of a given size, Cone Area-Contact Worm Gearing in operation naturally provides a cushioning oil film. It wears in, instead of "wearing out," is free from pitting and operates at a lower cost per horse power transmitted than any other known worm gearing.

Furthermore, this gearing possesses a wider range of applications



Showing how area contact occurs simultaneously between worm flanks and all meshing wheel teeth

—continuous operation at 30,000 r.p.m.—intermittent operation at four revolutions per hour under extreme loads—gear ratios as high as 100 to 1 and as low as 1 to 1—are examples of standard conditions under which Cone Worm Gearing is operating.

The whole secret of the success of the Cone Area-Contact Worm Gear lies in the practicability of the method and the means by which it is manufactured: Automatic generation of both worm and wheel blanks without cutting away stock essential to the finished tooth form.

Production

Corner of Michigan Tool Company plant showing several types of Cone Area-Contact Worm Gears in production

With the solution of the apparently simple, but exceedingly intricate production riddle represented by Cone Area-Contact Worm Gearing, cutting tools and machines for both large and small scale production covering the complete range of sizes, gear ratios and capacities have been developed. This machinery is available for manufacturers who choose to set up their own production and is also installed as standard equipment for manufacture of gears by the Michigan Tool Company to supply customers' requirements.

Complete information covering technical data on Cone Area-Contact Worm Gears, as well as details relating to production, operation and applicability, will be gladly supplied in response to inquiry.

MICHIGAN TOOL COMPANY
DETROIT, MICHIGAN

horsepower. This is bringing automobile and aviation practice close together and is exciting an extreme amount of interest in the supercharger. Other methods of achieving the same end, particularly through a marked increase in volumetric efficiency, are coming in for a great amount of study.

• • •

Pneumatic "Blasting" Is Safer

Certain coal mining areas in Illinois and Indiana are discarding dynamite blasting for pneumatic means of dislodging coal. With this new method a portable compressor stores air up to 15,000 pounds pressure in a long metal cartridge. The latter is inserted in a hole drilled in the face of the coal, after which a valve is actuated, thereby allowing the sudden expansion of air in the cartridge to push out the coal in large chunks.

• • •

New Policy for Engine Ratings

A new policy for engine ratings has been initiated by Pratt & Whitney Aircraft division of United Aircraft Mfg. Corp. Contrary to the general custom of the past, which is largely adhered to also at present, all P. & W. engines will be indicated by their "cruising rating" instead of by the power available only for limited periods.

• • •

Consider the Human Element!

This is something for designers of machines to think about. According to Dean F. W. Shumard of the National School of Time Study, the postures of operators' arms and other body parts, in standing or sitting positions, should receive particular attention on the part of time study men. The proper height of work whether the operator is standing or sitting should be about two inches below his elbow height.

• • •

Air Conditioning the Machine Shop

For the first time in the history of automobile manufacturing, temperature regulation and air conditioning are being installed in machine shops and foundries at the Ford Motor company's Rouge factory, largest industrial plant in the world. In the cylinder lapping room, tem-

perature regulation was undertaken because there was a variation in the size of cylinder blocks, depending on whether the day was very hot or cool. This variation was enough to cause an engineering problem. It is planned to extend the use of controlled temperature to rooms where cylinder blocks are bored and to those departments where crankshafts, camshafts, pistons and flywheels are finished.

• • •

Charts Lubrication for Clay Machinery

Correct lubrication now has been charted for the clay products industry, equipment for which is subjected to considerable abrasive wear due to the prevalence of dust, water and mud. Sinclair staff engineers co-operating with the leading clayworking equipment manufacturers have developed a simplified lubrication chart which now is available upon request to the company.

• • •

Now It's the Oil Burner Institute

At a recent meeting in Cleveland, the Oil Burner Institute was created to succeed the American Oil Burner Association Inc. Present members of the latter will automatically hold membership in the new organization. G. Harvey Porter, Baltimore, was appointed managing director.

• • •

Spraying to Retard Corrosion

Manufacture of gasoline entails pressures of 800 pounds and temperatures of 900 degrees Fahr., with resultant reduction from corrosion of the steel wall structures of about one-quarter inch per year. Oxyacetylene metal spraying is playing an important part in retarding this action. Four large refineries have sprayed several thousand feet of reaction chambers with aluminum during the past two years.

• • •

Striped Satin Finishes for Strip Steel

Strip steel in new and attractive finish has made its appearance on the market. Its design is composed of stripes or patterns rolled into the steel by specially ground rolls. Known as Satinstripe, the new material is available in many different kinds of stripes which vary in width and depth. Even when chromium, nickel or color finishes are applied the design is clearly visible. This material will have wide application in the fabrication of metal machine parts designed in the modern manner.

Your Machine Tools Need . . .

POWER DRIVES THAT WILL GIVE YOU FULL ADVANTAGE OF THE PRECISION AND PRODUCTION SPEED WHICH MAKE TODAY'S MACHINE TOOLS THE BEST BUY EVER OFFERED INDUSTRY

Diamond Roller Chain Drives will keep your production rate just where you want it and enable you to get the most out of your machinery because

- They are Positive — permit no slip: the speed of the driven shaft remains exactly at the rate selected for the job. There is no gradual slipping, no slowing down of production or efficiency.

When you specify Diamond Roller Chain Drives on your machines or put them in your plant you also get drives that are

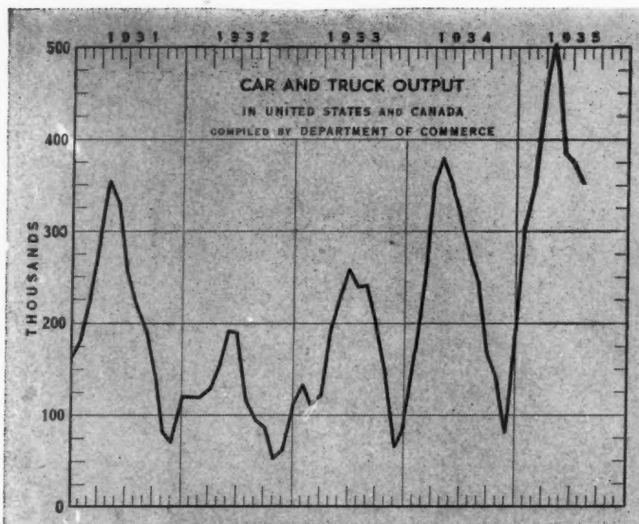
- Clean, Quiet and easy to install and take care of.
- Suited to short, medium or long centers; high, medium or slow speeds.
- Saving of Space; more capacity per inch of width than any other type of transmission.
- Saving of your Power Bills; 98-99% efficiency is permanently maintained.
- Saving of your Investment; they last longer.

Diamond Roller Chain Drives may be had through the machinery builder, our distributors located in all principal cities or from the factory. Drives to meet most requirements are carried in stock. One or two Diamond Drives installed in your plant will be thoroughly convincing of the advantages they have for you. DIAMOND CHAIN & MFG. CO., 435 Kentucky Ave., Indianapolis, Ind. *Offices and Distributors in all Principal Cities.*

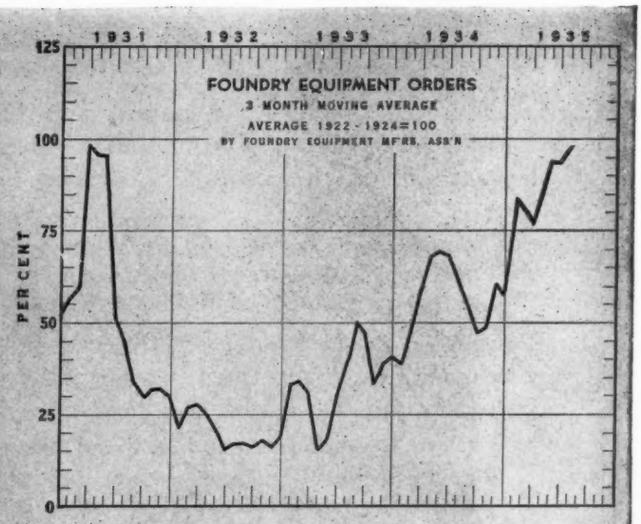
Diamond triple-strand chain on 7½ hp., 1750 R. P. M. drive; 19 teeth on motor sprocket, 106 teeth on driven sprocket.

DIAMOND CHAIN

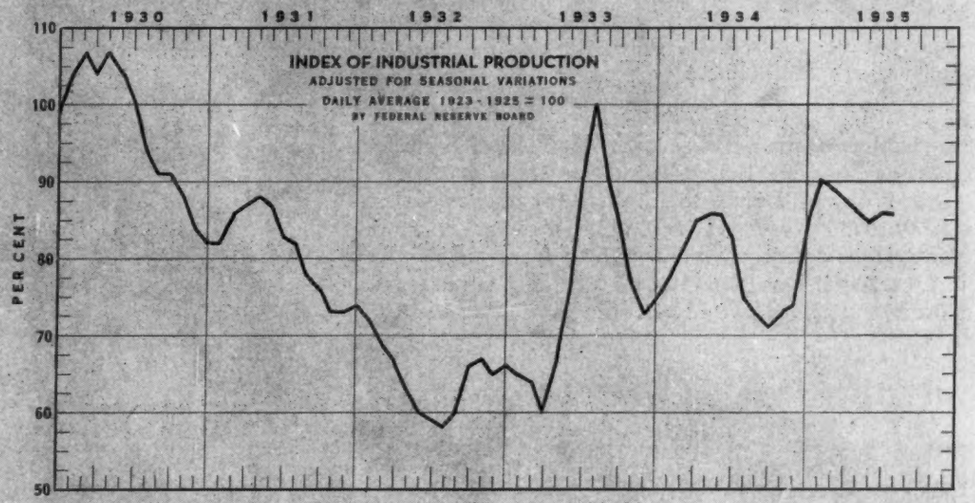
How Is Business?



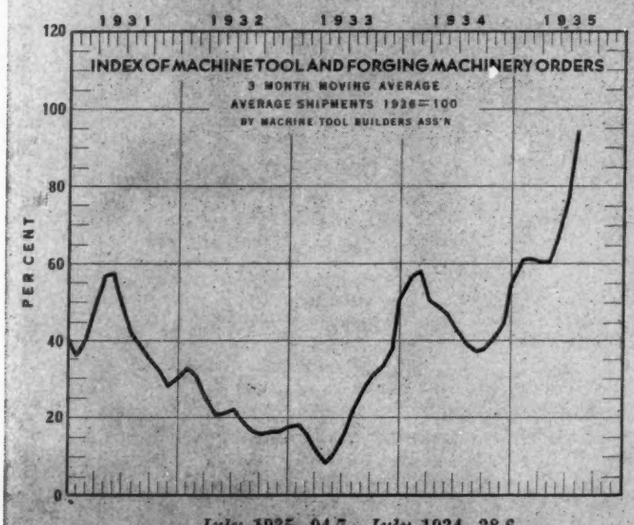
July 1935, 350,118—*July* 1934, 276,047



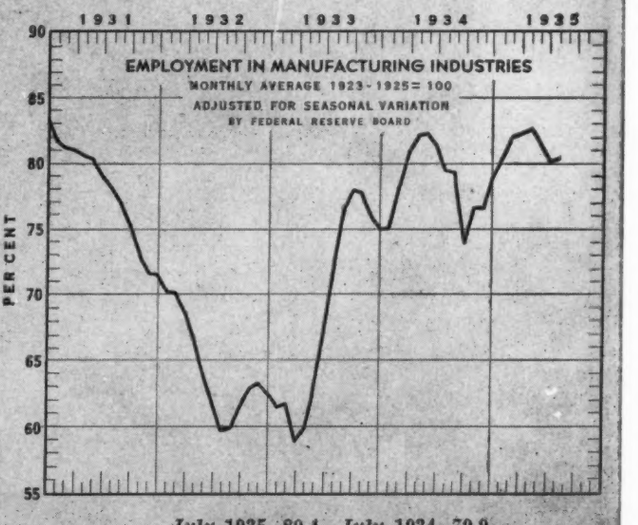
July 1935, 98.3—*July* 1934, 62.5



July 1935, 86—*July* 1934, 86



July 1935, 94.7—*July* 1934, 38.6



July 1935, 80.4—*July* 1934, 79.9

Noteworthy Patents

COMBATTING vibration in machine tools such as millers is made more difficult because of the fact that they are composed of a number of elastic systems, each having its own natural period of vibration. Thus each system may vibrate either at its own natural frequency or at some modified frequency resulting from contact with other systems, usually through association between cutter and work. To reduce or eliminate vibration or chatter from a milling machine, irrespective of the frequency or point at which it may develop during the process of the cut, Hans Ernst and Mario E. Martellotti have invented a dampener.

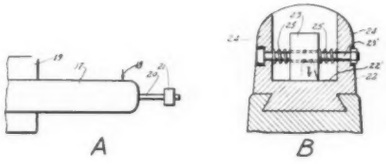


Fig. 1—Diagrammatic arrangement of device for combatting vibration

A simple form of tuned opposer is depicted diagrammatically at *A* in *Fig.* 1, in which member 17 may be assumed to represent a machine tool element such as the overarm of a miller, that is free to move at its natural frequency about a center of oscillation upon receiving a single instantaneous impulse from a disturbing force. To counteract any increase in amplitude an opposing member 20 may be attached to the end of member 17 and irrespective of its own natural frequency will be given a forced vibration, depending on the vibration of member 17. If member 20 is absolutely rigid, it will move in unison with member 17, the two moving as one member. On the other hand, if member 20 is resilient or in other words has a somewhat flexible connection with the member 17, its inertia will cause it to bend or deform first, and thereby to lag behind the movement of the supporting member, or more technically, to be out of phase with it.

If the mass of the opposer is changed by adding an inertia member or weight 21, its natural frequency will be changed, causing a corresponding change in phase relation between member 20 and the overarm. By making the weight adjustable it is possible to vary or tune the natural frequency of this auxiliary force system so as to make it equal to the frequency of oscillation of the disturbing force, in which case the phase relation between the motions of members 17 and 20 would become 90 degrees automatically.

Provision of artificial damping in conjunction with a tuned opposer may be accomplished in various ways. The two may be combined in a single unit as shown at *B, Fig.* 1. In this ar-

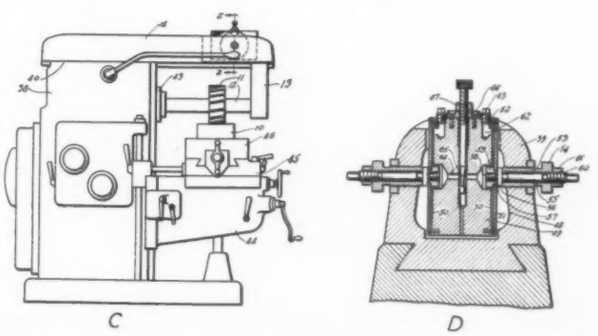


Fig. 2—Vibration eliminator applied to the overarm of a milling machine

rangement weight 23 is mounted upon the free end of overarm 24 and guided by rod 23′ upon which are mounted springs 25 between the sides of the weight and the sides of the overarm. Effect of these springs is similar to the resilience of the member 20 in that a certain potential energy is stored in the springs during movement of the weight by inertia in one direction and then released at the proper time to effect movement of the weight in the opposite direction. This construction constitutes a vibrator or opposer similar in action to that shown at *A, Fig.* 1.

An installation on a milling machine is illustrated at *C, Fig.* 2. In this construction the vibration eliminator may be applied to the overarm, and for this purpose the upper part of the member has been provided with an elongated slot 48, *D, Fig.* 2, in which is suspended the device comprising an inertia member or block 49. Due to the resilience of plates 51 it is apparent that upon vibration of the overarm, weight 49 will lag or in other words, will be out of phase with it to the extent of the resiliency of these plates.

Hydraulic dampening means also have been devised. Depressions 50 are filled with a liquid and connected by horizontal channel 64. A reciprocable valve member 65 extends through the top of block 49 where it is threaded in a bore 66 and provided with a locknut 67 for retaining it in any adjusted position. Vertical movement of plunger 65 will vary the restriction in the channel 64, controlling the rate of flow of the liquid from one depression to the other and thereby determine the amount of energy absorbed by the deformation of one of the plates and the resultant deformation and transfer of the fluid body in the adjacent reservoir.

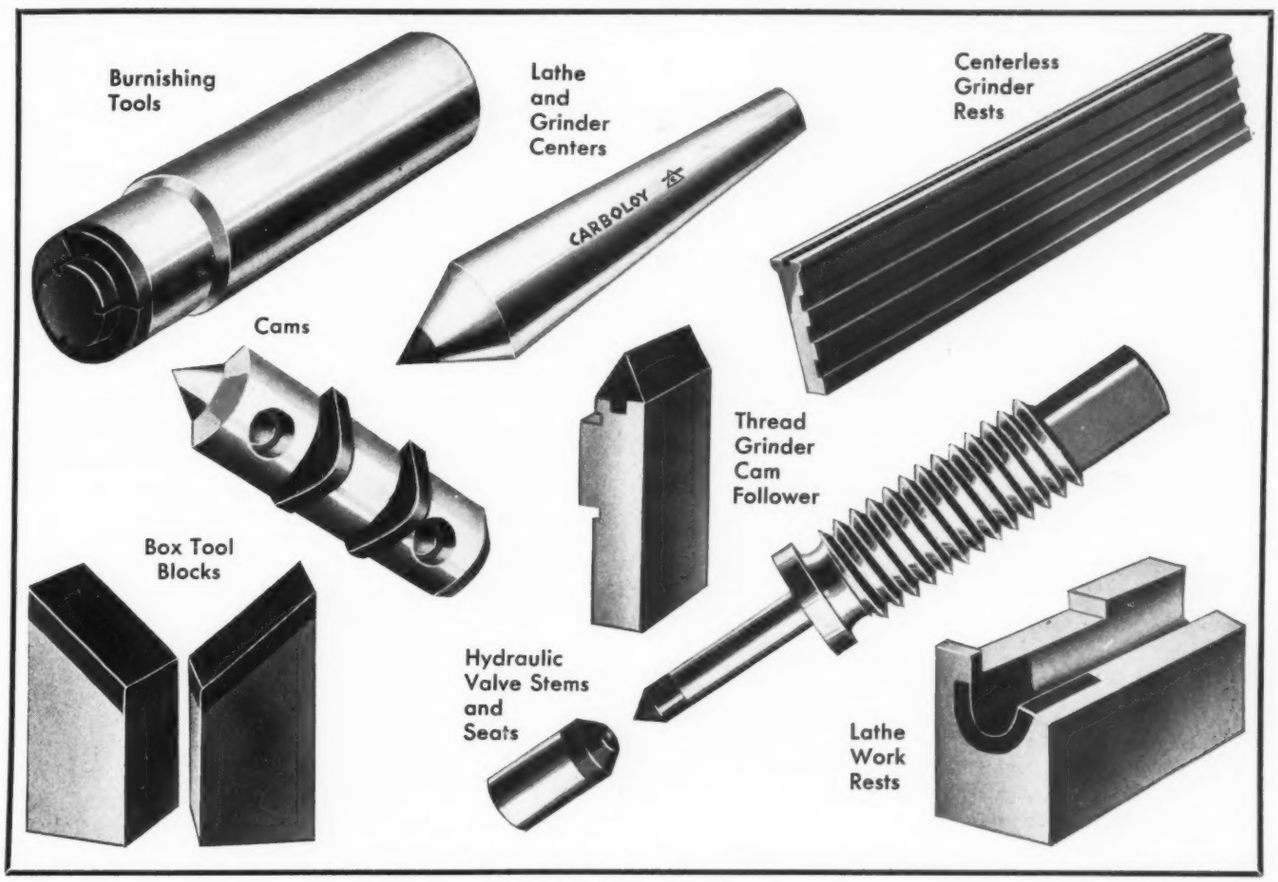
This patent designated No. 1,965,224, is assigned to Cincinnati Milling Machine Co.

FREE machining alloy steels containing selenium are covered in patents recently granted to Frank R. Palmer, assistant to the president of the Carpenter Steel Co., to which organization they have been assigned. The utility of selenium as a free machining element has been established during the past few years through its extensive use in 18-8 chromium nickel stainless steel. It is revealed now that this same selenium gives promise of successful use in practically all other types of iron and steel products.

Sulphur has been used extensively in low carbon non-alloy steels that are familiar to the trade under the general name of "screw stock." Sulphur combines with certain metals in the steel, usually manganese, to form non-metallic sulphides which occur in the form of slag-like stringers in rolled or drawn bars.

It is claimed that selenium is superior to sulphur as a free machining element in two import-

Carboloy Gives You Up to 50 Times Greater Life On Machine Tool Parts Having Rapid Wear



You need only a small insert of hard, wear-resistant Carboloy at the point of wear on your parts to lower downtime and part replacement cost, reduce "reject" expense, and increase the operating efficiency of your machine tool equipment.

Carboloy cemented carbide has a high resistance to abrasive and corrosive wear. Rockwell's as high as 97.5 on the "A" scale. This "diamond-like" material gives you up to 50 times greater life than ordinary metals. And it's easy to apply,—just braze in a small insert at the point of wear. A few typical applications are shown above. These and others are described in our latest booklet free on request. Just send the coupon below.

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ant particulars. First of all, a given percentage of selenium does not produce nearly as much slag-like material as an equal percentage of sulphur, so that the cleanness and uniformity of the product are greatly increased. Secondly, selenium is more potent in its free machining effects than sulphur, therefore a smaller percentage of selenium is required in order to produce the same free machining effect.

Offsetting the natural advantages that selenium has over sulphur as a free machining agent, there appear to be two disadvantages. In the first place, selenium is more expensive than sulphur so that its use will doubtless be reflected in the higher price of the product. In the second place, all of the work done thus far has been on electric furnace melted steel which is rather conducive to higher quality than lower costs. It seems likely, therefore that the applications of these new free machining alloy steels will be somewhat selective and at least temporarily may be limited to the manufacture of parts in which the machining costs are relatively high compared to the weight of steel involved.

WITH increased attention being focused on the use of hydraulics in machine tool design, it is fitting to review briefly some of the features of a lathe recently patented by E. P. Burrell for Warner & Swasey Co. The turret slide 22, *Fig.* 3 is reciprocated on ways 21 by means of an hydraulic motor comprising a cylinder 50, *Fig.* 4, movable with the slide, and a piston and piston rod 51 fixed in respect to the bed of the machine.

Valve 43, *Fig.* 3, controls the direction and rate of the pressure fluid to the hydraulic motor. Pressure fluid entering cylinder 50 causes the cylinder and slide to move rapidly forward toward the head of the machine for a certain distance, after which the control device 42 actuates valve 43 to reduce automatically the amount of incoming fluid. The slide then moves more slowly toward the head.

When the slide reaches the predetermined position at which the feeding movement is to cease,

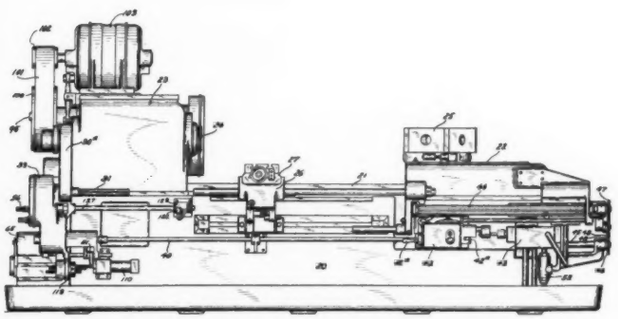
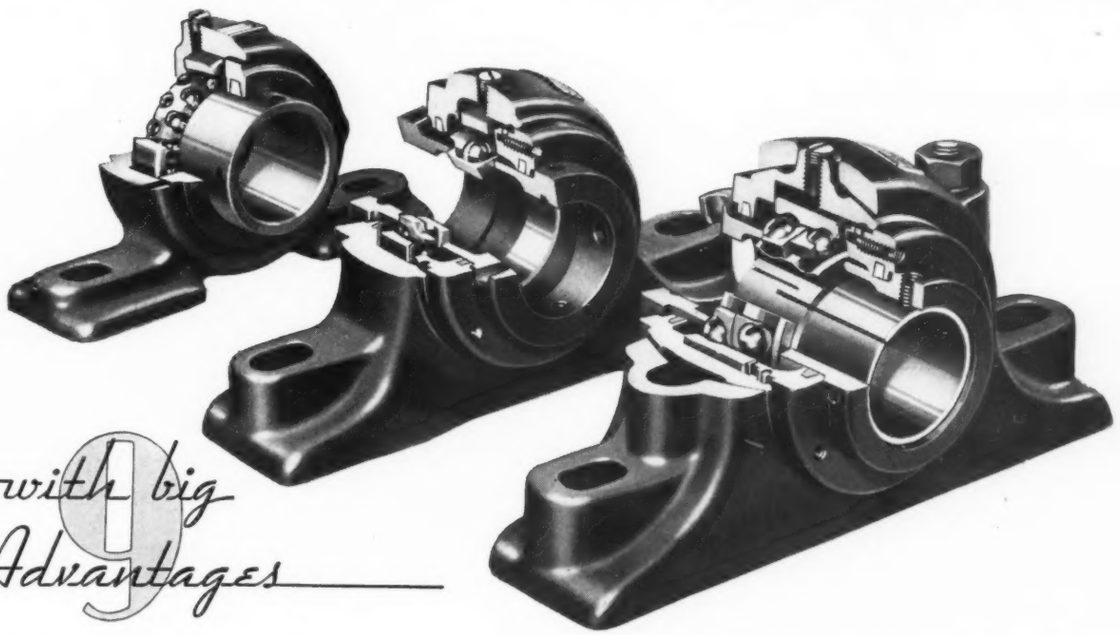


Fig. 3—The turret slide is reciprocated on the ways by means of an hydraulic motor

here they are . . .

the NEW CJB PILLOW BLOCKS



. . . with 9 big Advantages

1 Supplied in Unit Type (light, normal, and medium duty) and Ball and Socket Type (Standard and heavy duty) thus providing two distinct types which permit a selection of nine capacities for a given shaft size (inch dimension) and four additional capacities for each standard metric shaft diameter.

2 All types are fitted with felt seals to prevent entrance of foreign matter and to retain lubricant. In addition the Medium and Heavy Duty Types are equipped with a labyrinth closure necessitating no added cost for flingers or special closures.

3 The Standard and Heavy Types are made with a ball and socket type of housing which permits the installation of a heavy duty rigid type double row ball bearing and includes features which compensate for variations in the alignment of base and shafting.

4 The Standard and Heavy Types also employ a patented method of drawing the bearing onto the adapter. Easily located and fixed to the shaft without opening Pillow Block. Cannot overload bearing by reason of too much take-up, yet due to wrapping action of adapter around shaft, the possibility of slippage is eliminated. The adapter, being of one-piece special construction, permits the use of oil for lubrication, which is very desirable at high speeds without loss of lubricant.

5 The Medium Duty Straight Bore Type, No. 92000 Series, provides for mounting directly on the shaft. This is recognized as the superior method if shafting is held to close tolerances. This Type can be supplied in either inch or metric bores.

6 Both Medium and Heavy Duty Types employ a patented locking device for fixing the end cap without the use of threads; therefore the direction of shaft rotation is optional.

7 The Medium Duty Type, when employed for exacting applications, utilizes a countersunk shaft, using the drilled holes as a drill bushing. The collar is then rotated 90 degrees and the set screws placed in position. The offsetting of the drilled and tapered holes provides an internal pressure against the inner ring, thus locking it securely to the shaft.

8 The Heavy Duty Tapered Bore Type is designed for mounting on standard shafting and compensates for a normal amount of variation in tolerances.

9 Aside from their mechanical perfection these new Pillow Blocks are noteworthy examples of modern machine design in which appearance and ruggedness have been combined in a most pleasing effect. Units are finished in silver grey with red trim.

THE Ahlberg Bearing Company with its firmly established reputation for bearing quality and dependability now presents a new and remarkable line of Pillow Blocks designed to meet an unusually wide range of applications and embodying the most noteworthy improvements in the last 20 years.

Ahlberg, fully aware that anti-friction bearings, being precision products, must be properly housed in order to render maximum benefits, has concentrated its entire experience and engineering skill on this latest development. Every aim and expectation has been more than realized in the result and a study of the new and unique features listed at the left will offer convincing reasons for their superiority and why they will add better performance, greater sales value and a more pleasing "eye-appeal" to any product requiring pillow blocks. Write for temporary engineering data or see them at Booth E—301, Machine Tool Show.

AHLBERG BEARING CO.
400 EAST 29th STREET, CHICAGO

extension 50*a*, *Fig.* 4, of cylinder 50 engages with one of the adjustable abutment screws 56 of a stop roll 57 and the forward feeding movement is arrested, a period of dwell being provided by the control mechanism in this position before the slide commences its return movement. Indexing of the stop roll 57 brings a different adjustable abutment screw 56 into alignment with extension 50*a* to change the point of dwell at which the feeding of the slide ends and the rapid return movement commences.

Stop roll 57 is rotatably mounted in bed 20 at the head end of the machine. A shoulder 58 is arranged on one side of the bearing for the stop roll and a gear 59 integral with the stop roll is provided at the opposite side of the bearing. Shoulder 58 and gear 59 retain the stop

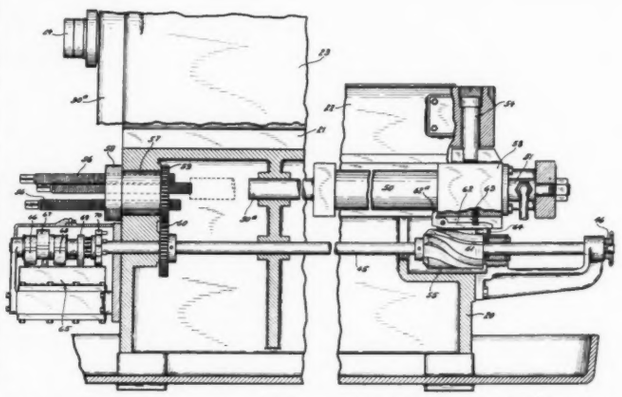


Fig. 4—Indexing of stop roll controls point at which feeding of slide ends

roll in position and the latter further serves to take the thrust when the extension 50*a* of cylinder 50 engages with one of the adjustable screws 56 carried by the stop roll.

Gear 59 on the stop roll 57 meshes with a gear 60 fixed on control shaft 45, whereby the stop roll will be indexed in timed relation with the return movement of the slide and with the indexing of the turret.

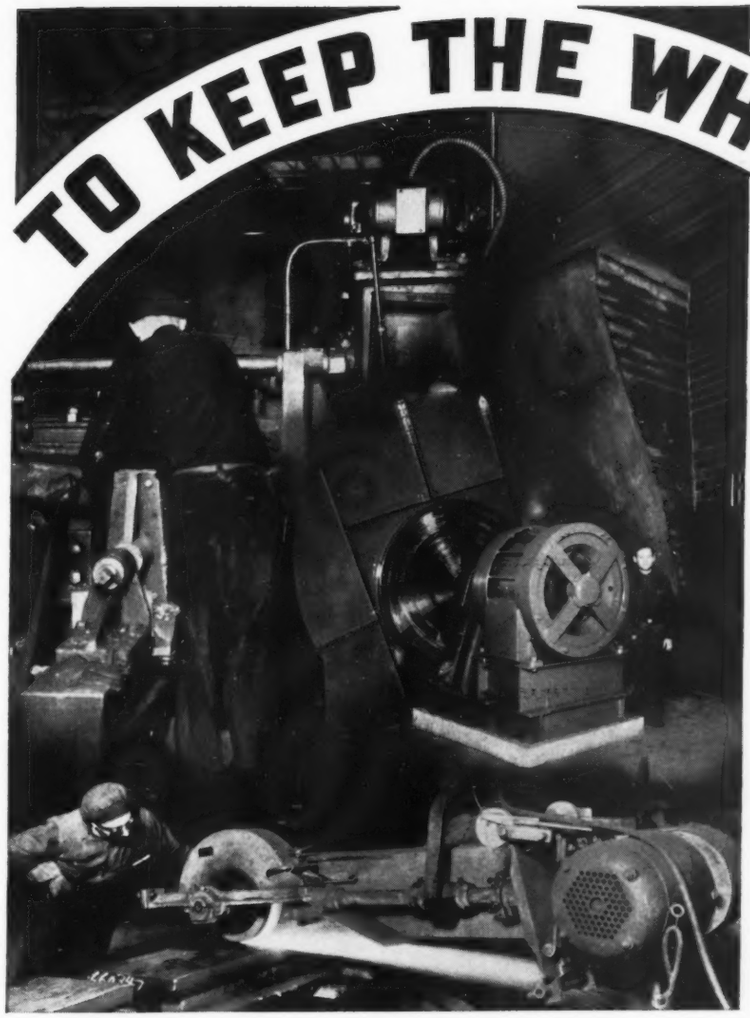
During forward movement of the slide and cylinder 50 roller 64 will ride over the surface of cam 55, and the arm 62 to which the roller is attached will be swung upwardly on its pivot, depressing spring 63 and moving the upwardly extending portion 62*a* out of engagement with head 53.

The parts are designed to again cause rotation of the control shaft 45 to index cam 55 and as the slide 22 moves rearwardly at the end of the next cycle of operation roller 64 will engage in one of the cam grooves 61 and will rotate control shaft 45 through one-fifth of a revolution.

In addition to the foregoing, control devices are located in the head of the machine for shifting the valves which govern the different operating speeds of the spindle.

Number of this patent is 2,005,822.

TO KEEP THE WHEELS TURNING



TO KEEP the wheels turning requires the best of qualities in both men and motors. We, at Lincoln, accept it as our responsibility to see to it that "Linc-Weld" motors have more than the required horsepower to keep your wheels turning. This extra horsepower, available in every "Linc-Weld" motor, assures you of extra protection against failure.

And the "Linc-Weld" motor is also amply protected against the attacks of dust, dirt and acid fumes. Its waterproof insulation is permanently pliable—will never dry out or crack.

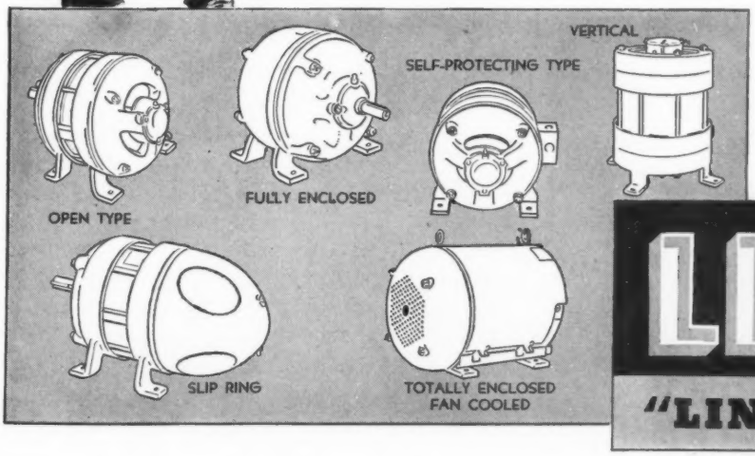
The "Linc-Weld" frame is built of skyscraper construction—rolled steel for greatest strength and rigidity with least bulk. Thus it contains more iron and more copper to give "Linc-Weld" the extra horsepower without sacrifice of power factor or efficiency.

We suggest that if it is responsibility to keep the wheels turning you investigate all the advantages "Linc-Weld" motors can offer you. Write THE LINCOLN ELECTRIC COMPANY, CLEVELAND, OHIO.

M-17

POP "You know, Lad, you never get anything for nothing. Now who pays for the extra overload capacity of the 'Linc-Weld' motors?"

LAD "That is one of the profits of progress, Pop. The 'Linc-Weld' user profits by Lincoln's progress in motor design. As long as you buy old style motors you pay for the losses of lethargy."



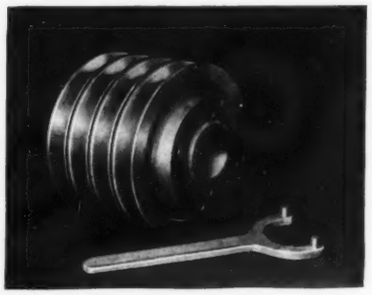
LINCOLN

"LINC-WELD" MOTORS

NEW *Materials and Parts*

Sheaves Provide Variable Speed

BY MEANS of an exceedingly simple adjustment the pitch diameter of the new Varipitch Texrope sheave, built by Allis-Chalmers Mfg. Co., Milwaukee, can be changed so as to give variations in speed as high as 15 to 25 per cent per sheave. If both sheaves of a drive are of this new type the range of variations can be doubled. These new sheaves, shown herewith, are made in two multi-groove types, stationary and motion controlled. The stationary controlled type is recommended for applications that require occasional change of speed. The motion controlled type is recommended for applications that require frequent quick changes within the full range while the drive is in operation.



Variations of speed as high as 15 to 25 per cent can be obtained with adjustable sheave

The new sheave, which retains all of the inherent characteristics of V-belt sheaves, permits higher or lower speed operation according to the respective product range requirements of the driven machine. The sheave is especially desirable for the type of V-belt drive which formerly employed several sets of sheaves to meet the need for occasional changes in speed.

Introduces Oilproof V-Belts

COMPLETELY oilproof, the new "Daycoil" V-belt of Dayton Rubber Mfg. Co., Dayton, O., is expected to find application in machine tools and other machinery where excessive oil in connection with power transmission has long been a problem. The oilproof material used in the V-belt has all of the properties of natural rubber, such as flexibility, plasticity and resiliency, plus aging properties better than that of rubber, and good abrasive and wearing qualities when subjected to oil and solvents.

These V-belts carry the same laminated construction principles as in the Cog-Belts built by

● There is no landing field in Cloudland . . . no place on star or neighboring planet where a bearing might be replaced. So for safety . . . dependability . . . performance . . . airplane manufacturers and engine builders almost without exception equip with SKF . . . the bearings that have been used on practically every successful transoceanic flight.

On the long list of aircraft that have been SKF - equipped appear such world-renowned names as the Spirit of St. Louis, the Columbia, the America, the Question Mark, the Winnie Mae, the Macon, the Graf Zeppelin, the Martin Clipper Ship and planes of the great air transport companies and of the United States Army and Navy. SKF Industries, Inc., Front St. & Erie Ave., Philadelphia, Pa.

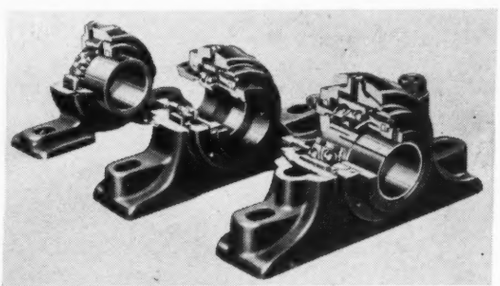
SKF

BALL AND ROLLER BEARINGS

the company for general transmission applications, but include a specially designed casing of the new synthetic compound to resist oil.

Enlarges Line of Pillow Blocks

PILLOW blocks in a line which has a unit for virtually every need and every duty are a recent development of Ahlberg Bearing Co., 321 East Twenty-ninth street, Chicago. The units are now available in the unit type (normal and medium duty) and the ball and socket type (standard and heavy duty) in addition to the present E C or light duty type, thus providing nine capacities for a given shaft size (inch dimension) and four additional metric shaft diameters. All types are fitted with felt seals to prevent entrance of foreign matter and to retain lubricant. In addition, the medium and heavy duty types are equipped with a labyrinth closure.



Added sizes make available a complete and varied line of pillow blocks

Both medium and heavy duty types employ a patented locking device for fixing the end cap without the use of threads; therefore the direction of shaft rotation is optional. The medium duty type, when employed for exacting applications, utilizes a countersunk shaft, using the offset drilled holes in the collars as a drill bushing. The collar is then rotated 90 degrees and setscrews placed in position. Offsetting of the drilled and tapered holes provides an internal pressure against the inner ring, thus locking it securely to the shaft.

Nonbleeding Plastics Developed

MOLDED plastic parts exposed to acetone and other strong solvents or acids sometimes are subject to bleeding of the dye. To overcome this difficulty General Plastics Inc., North Tonawanda, N. Y., has recently brought out a nonbleeding material called 3973 Black. Although originally developed to overcome the bleeding troubles in molded bottle caps in contact with strong solutions, the new material has found

This name plate

gives capacity in horsepower according to the formula established by the American Gear Manufacturers Association. A nameplate of this character will be affixed as soon as possible to the products of the companies whose names are listed below:

An important announcement to users of SPEED REDUCERS

The American Gear Manufacturers Association has unanimously adopted as Recommended Practice rating formulas for determining the capacity of any standard helical or herringbone geared speed reducer or any heavy duty worm geared speed reducer. These Formulas are the result of several years of experimental work and mathematical research by a Committee of Engineers especially appointed for the purpose by the A. G. M. A.

Previously much confusion and lack of uniformity existed in the rating of speed reducers which was obviously detrimental to the interests of the purchaser. The A. G. M. A. Ratings now adopted solve this vital problem. They are simple to apply, and are equally applicable for normal or for severe service, it being necessary merely to apply the correct service factor as given in tables when selecting a speed reducer for any individual purpose.

IN YOUR OWN PROTECTION YOU SHOULD SPECIFY A.G.M.A. RATINGS FOR YOUR SPEED REDUCER REQUIREMENTS. Write any of the manufacturers whose names appear below:

THE CLEVELAND WORM & GEAR CO.
3249 E. 80th Street — Cleveland, Ohio

DE LAVAL STEAM TURBINE CO.
Trenton, New Jersey

THE FALK CORPORATION
Milwaukee, Wisconsin

FOOTE BROS. GEAR & MACHINE CO.
5301 So. Western Blvd. — Chicago, Illinois

FOOTE GEAR WORKS, INC.
1301 S. Cicero Avenue — Cicero, Illinois

THE HORSBURGH & SCOTT CO.
5114 Hamilton Ave. — Cleveland, Ohio

W. A. JONES FOUNDRY & MACHINE CO.
4401 W. Roosevelt Road — Chicago, Illinois

LINK-BELT COMPANY
910 S. Michigan Ave. — Chicago, Illinois

PACIFIC GEAR & TOOL WORKS, INC.
1035 Folsom Street — San Francisco, Calif.

PALMER-BEE COMPANY
Detroit, Michigan

PHILADELPHIA GEAR WORKS, INC.
Erie Ave. & G. Street — Philadelphia, Pa.

WATSON-FLAGG MACHINE CO.
Paterson, New Jersey

WESTERN GEAR WORKS
9th Ave. So. and King St. — Seattle, Wash.

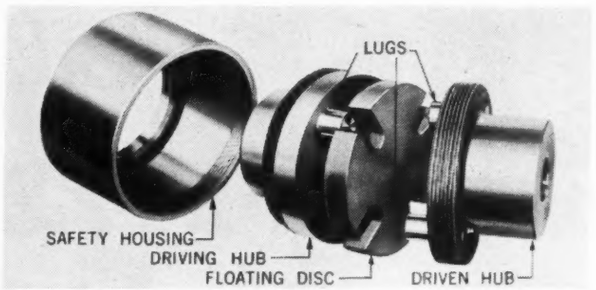
WESTINGHOUSE ELECTRIC & MFG. CO.
Nuttall Works — Pittsburgh, Pa.

application in general industrial and machine uses. Combined with a low moisture absorption rate of 0.7 per cent (ASTM) Durez 3973 has a rich high gloss finish and high torsional strength. Its nonbleeding quality is of value for textile machinery parts where any bleeding of the dye under the action of the solvents would prove troublesome. The material has a comparative strength of 30,000 pounds per suare inch (ASTM).

Coupling Is Self-Aligning

A SELF-ALIGNING coupling for use in direct connected drives has been developed by the Alloy Products Corp., Waukesha, Wis. It is self-adjusting so as to compensate for parallel as well as angular misalignment.

In tests the new couplings have operated satisfactorily with parallel misalignment of as much as 5/16-inch and with angular misalignment of 3 to 6 degrees. They may be used at any speed. A typical example of many applications is on a 10-horsepower motor drive operating at 5600 revolutions per minute.

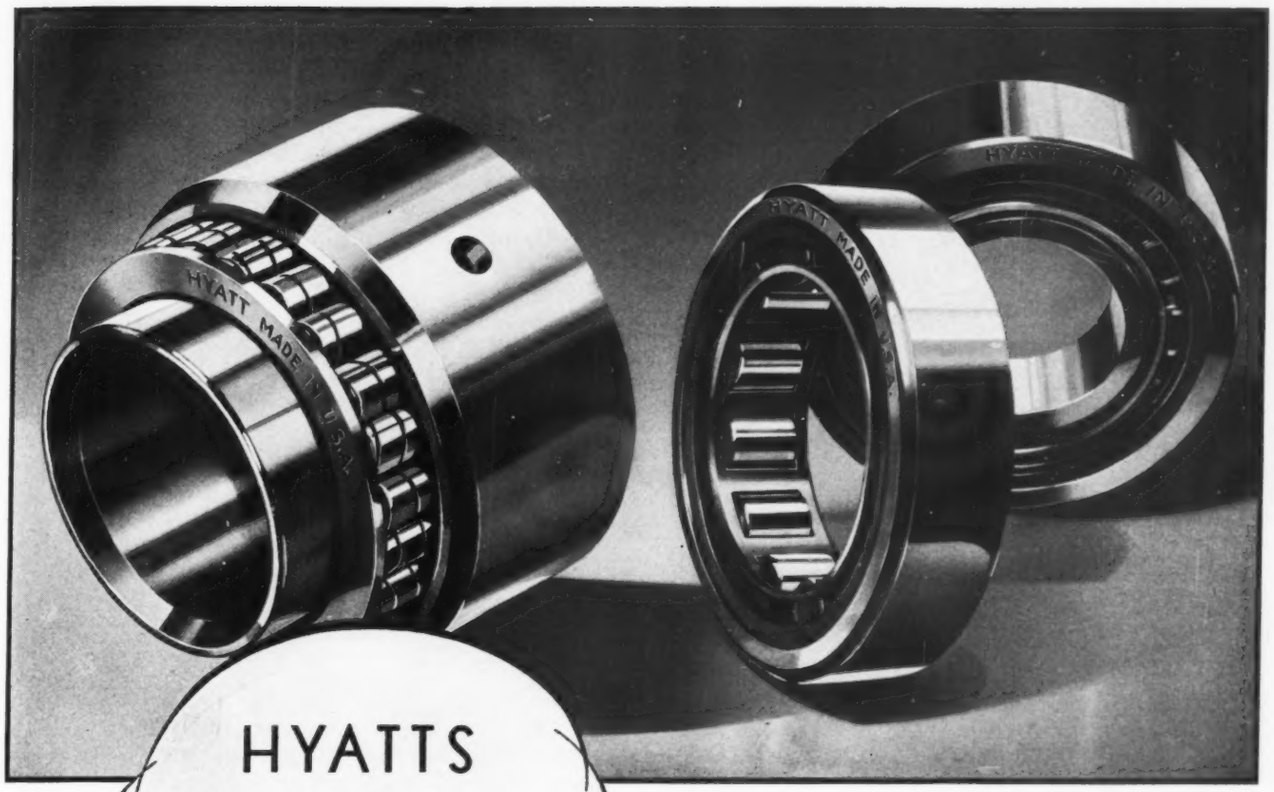


Self-aligning coupling maintains accurate alignment under adverse conditions

The new coupling plays the part of a safety valve between the motor and drive bearings and its use is said to eliminate the necessity for shimming in order to obtain and maintain accurate alignments. It operates noiselessly and is said to reduce power losses.

Double Reduction Units Redesigned

A SERIES of double reduction units for use on vertical drives has been added to the line of speed reducers being manufactured by Winfield H. Smith Inc., Springville, Erie Co., New York. One of the units in this new series, designated BDV, is shown herewith. The high speed shaft of the units, equipped throughout with antifriction bearings, is an integral part of the worm and although the standard location for this shaft is in the horizontal plane it can, if



HYATTS *Save as they Serve*

In the modern machinery which is reducing production costs and helping to make better products, Hyatt Roller Bearings are playing an important part, as may be seen in much of the equipment on display at the MACHINE TOOL SHOW—Cleveland—September 11-21. The Hyatt Exhibit will be in space A409.

It is a well-known fact that Hyatt Roller Bearings are serving everywhere. And, as they serve, the user can tell you how they save, too.

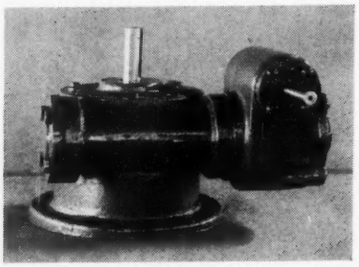
They save wear and tear on the equipment and help give it longer life. They save lubricant and the time necessary to apply it. And, because they assure smoother running, they save power.

Thus, the millions of Hyatt Roller Bearings which for years have served so well, are advance proof of how long the new millions will carry on whenever applied. Hyatt Roller Bearing Company, Newark, Detroit, Chicago, Pittsburgh, San Francisco.

H Y A T T
ROLLER BEARINGS
PRODUCT OF GENERAL MOTORS

desired, be assembled vertically or at an angle. The slow speed shaft can be assembled to extend vertically up or down as the customer may require.

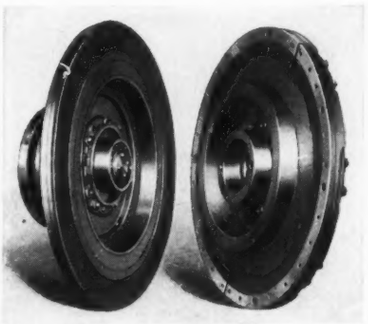
All worms are hardened and the threads are ground and polished. The worm gears are of a special alloy worm gear bronze. Ratios of reduction for this BDV series can be had from 75:1 to 3000:1. Torque capacities of the standards units up to 15,000 inch pounds are obtainable.



All worms are hardened and the threads are ground and polished in new series of double reduction units

Magnetic Clutches Are Improved

GENERAL purpose magnetic clutches with a number of important improvements are now being manufactured in a new design by Cutler-Hammer Inc., 238 North Twelfth street, Milwaukee. An outstanding feature of the new clutch, shown herewith, is the method of adjusting the friction faces to compensate for wear and to assure uniform lining engagement. The inner circumference of the field ring is threaded and the adjustment is made by rotating the field ring, in respect to the magnet field member, and consequently moving it toward the friction surface on the armature member. When the field ring has been moved forward sufficiently to compensate for the wear it is locked firmly in position.



Adjustment for lining wear in new clutch is made by rotating the field ring in respect to the field member

A floating magnet armature is used in the design of the new clutch, making it impossible to score the magnet pole faces even if proper

An old name . . . a new product

any SPEED DIEHL IXL GEAR MOTORS *any* POWER

For half a century the name Diehl has been synonomous with quality in electric motor design and manufacture. Now, through association with Foote Brothers Gear & Machine Co., Chicago, Ill., having an equal reputation and 75 years of experience in the mechanical field, Diehl presents a complete line of quality gear motors and speed reducers for every speed reduction drive. Illustrated above is a group of representative units, including helical and worm gear drives in both built-in and coupled types. Equipment to meet most industrial requirements can be shipped from stock. Special units can be supplied in a minimum of time. Diehl "IXL" Gear Motors and Speed Reducers make possible appreciable economies in the installation, operation and maintenance of industrial drives because of their simple construction, ease of application, efficient performance and small space requirements. Write for complete information. Diehl Manufacturing Company, Electrical Division of The Singer Manufacturing Company, Elizabethport, N. J. District Offices in Atlanta, Boston, Chicago, Dallas, New York, Philadelphia.

Simplified Price-List and Catalog contains valuable information for the motor buyer, arranged for quick and easy reference. Write for a copy.

DIEHL MOTORS

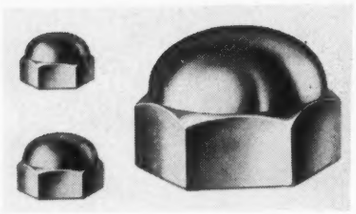
5618

adjustment on the lining is not maintained. This feature overcomes the disadvantages of the conventional single friction face clutches, on which grooving and scoring of the magnet poles results from improper maintenance of lining adjustment. Other features of the new design include a magnet coil which may be readily removed and replaced as a unit, rugged bronze collector rings, a lining wear indicator, and a pilot bearing to insure concentric engagement of the two members.

Fastenings Are Cold Forged

APPLICATION of a new cold-forging process to the manufacture of cap nuts, wing nuts, thumb screws and similar small parts has recently been introduced by Parker-Kalon Corp., 200 Varick street, New York. The new process is said to add materially to strength, uniformity and finish. Die-formed to shape, the parts have a finish free from tool marks and sufficiently smooth to eliminate the need for polishing before plating, or buffing after plating.

In the case of cap nuts produced by the new process, holes are countersunk before tapping, and the tapping itself is held to close tolerances. The base of the nuts are faced off and the corners chamfered, permitting them to seat flush without danger of marring highly polished surfaces. In the stock finish of natural brass, seven blank sizes are available with standard screw-thread sizes from No. 6 to $\frac{5}{8}$-inch. Plated finishes can be furnished, as well as nuts of aluminum, copper, etc., in standard or special threading.



Holes in cap nuts, fabricated by cold forging, are countersunk before tapping

Hydraulic Units Employ Modern Design

MODERN design which tends to enhance smooth lines, general appearance, efficiency and usefulness has been adapted to the hydraulic power units built by Ex-Cell-O Aircraft & Tool Corp., Detroit. These units, compact and self-contained, are adapted for drilling, reaming, counterboring, spotfacing and similar operations. They can be mounted either single or in multiple and are not limited to any one position.

The smaller unit, No. 23A, shown herewith,

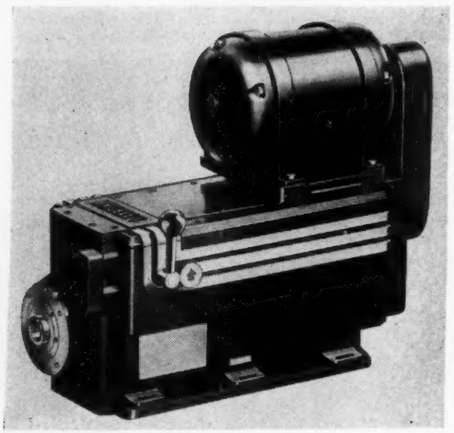
TIME... AND *HEAT*, WAIT FOR NO MAN

● The man who first coined the expression "like greased lightning" must have been watching an alloy bar mill in operation.

Speed . . . controlled speed . . . sometimes fast, sometimes slow . . . is of vital importance in securing the proper physical qualities in alloy steel. For speed is a means of controlling the temperature of the steel during the forming operations. Illinois Steel Company has provided every modern means for controlling speed and temperature in its alloy production. This is one reason, and a big one, why users have learned that Illinois Alloy Steel maintains quality consistently and uniformly whether you buy a bar at a time or in thousand-ton lots.

ILLINOIS STEEL COMPANY
208 SOUTH LA SALLE STREET, CHICAGO, ILLINOIS

United States Steel Corporation Subsidiary



Hydraulic units are not limited to any one position on the machine

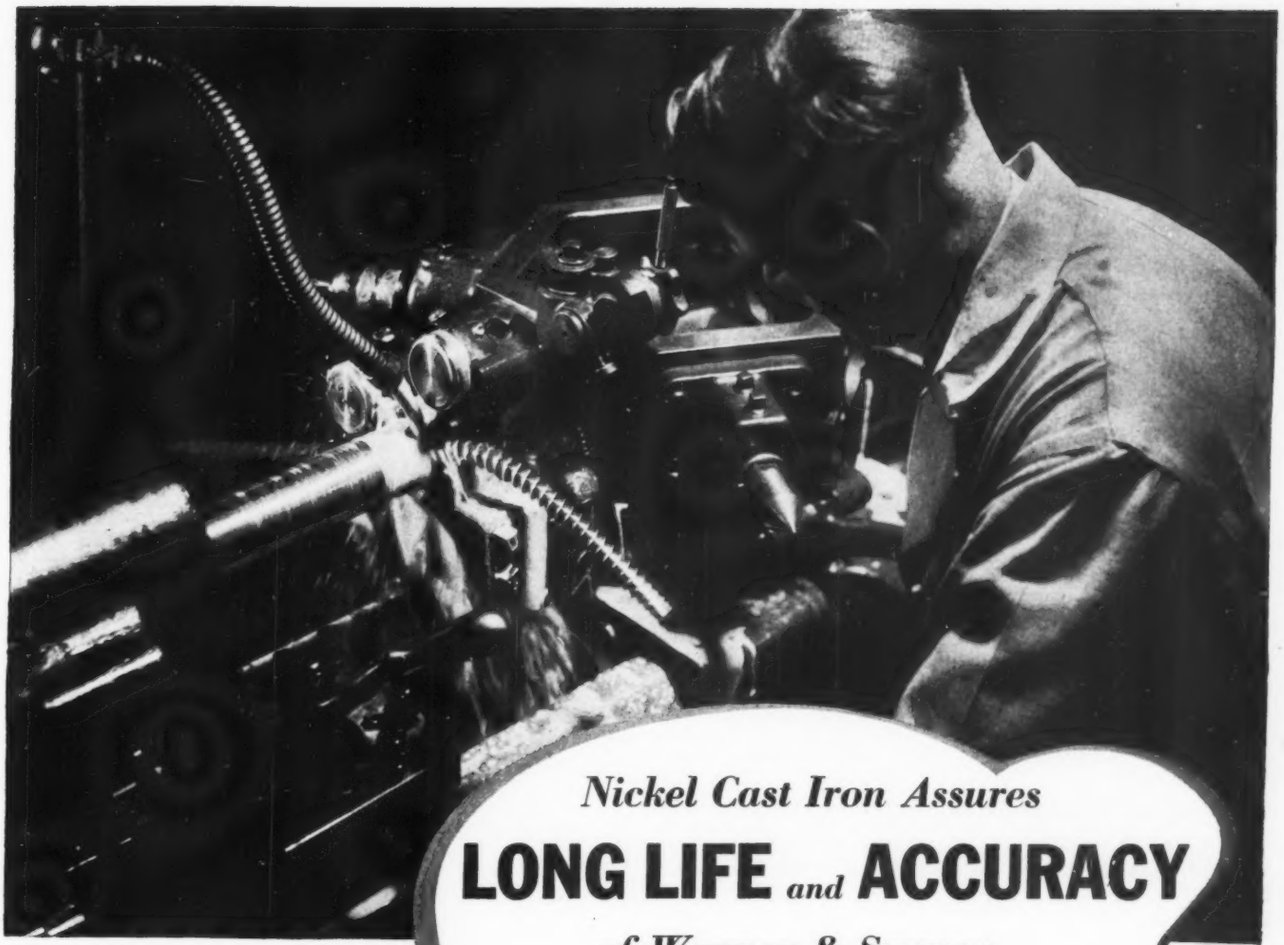
has an eight-inch stroke, while the larger unit, No. 25A, has a ten-inch stroke. Range of speed on No. 23A has been increased to 1 to 32 inches per minute with a rapid approach and return of 300 inches per minute. On the No. 25A unit the range of feed has been increased to 1 to 32 inches per minute with a rapid approach and return of 230 inches per minute. Adjustable dogs control the rapid approach, feeds, return and stop. Two forward feed rates, independently adjustable from the side of the unit, permit selection of the proper rate while the unit is feeding. Speed of the spindle can be changed by removing the cover plate on the rear of the unit and changing the speed gears.

New Belts Are Oil Resisting

ABSOLUTE oil resistance is available in a new type of belt offered by L. H. Gilmer Co., Tacony, Philadelphia, in both V-type and Flat Kable Kord type. Mechanically, the new belts have the same qualities as the regular rubber-fabric type of belt. Materials used, however, are such that either type of belt, V or Flat, is oil resisting and practically impervious to the destructive inroads of oil vs. rubber. There are many applications in machines where an oil resisting type of belt is essential, both in V-type and flat belts.

Introduces New Small Clutches

SMALL clutches in three sizes with 5⅝, 4½ and 3½ inches outside diameters in a single plate for fractional horsepower and multiple plate for heavier drives have been introduced by Conway Clutch Co., 1546 Queen City avenue, Cincinnati. The clutches, shown herewith, can be operated singly or doubly, or for forward and



Nickel Cast Iron Assures

LONG LIFE *and* ACCURACY

of Warner & Swasey Turret Lathes!

MODERN MACHINE TOOLS owe much of their superior power, speed and accuracy to the marked improvement in modern engineering materials . . . especially the alloys containing Nickel.

Warner & Swasey are liberal users of these Nickel Alloys and the following tribute to Nickel Cast Iron is quoted from a recent statement of President P. E. Bliss:

"The reputation that Warner & Swasey turret lathes have won over the past fifty years, can be attributed to the painstaking accuracy of our engineers and the high quality of workmanship and materials that go into these machines.

"Take the bed or base of these turret lathes for example. They must withstand all the stresses and strains imposed on the machine and maintain their original accuracy.

"In making our castings The Sterling Foundry Company, Wellington, Ohio, uses 1½% nickel to obtain a nickel high test iron made with an 80% steel mixture, attaining a very low carbon content and unusually fine distribution of graphite. And although these castings in certain instances have a hardness of 260 Brinell and a tensile strength as high as 50,000 pounds per square inch, they are readily machinable.

"These castings are exceptionally uniform in density or grain in all the variable thin and thick sections and are built to the maximum machinable hardness, producing a very fine finish. Without the use of your nickel we would be unable to obtain the same machinability, using the same base analysis. In consequence we claim definite high quality for our product through the use of your nickel."

• • •

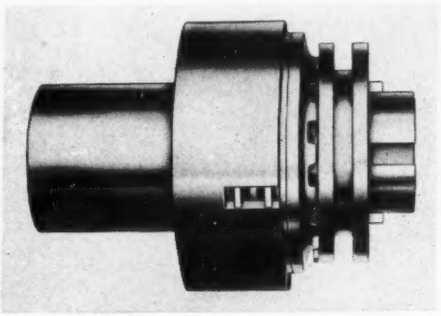
In addition to machine tool equipment Nickel Cast Irons are being used today with success and economy for a wide variety of castings . . . for internal combustion cylinder blocks, heads, liners and pistons; locomotive cylinders and parts; gears; cams; pump bodies, valves and parts; compressor parts; steel mill rolls; grinding, crushing and sizing equipment; plow points, mold boards, etc.

Our casting specialists will gladly cooperate in selecting compositions best suited to your requirements.

NICKEL CAST IRONS

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York, N. Y.
Miners, refiners and rollers of Nickel
Sole producers of Monel Metal

reverse drive, either dry or in oil. They follow a design similar to the larger size clutches manufactured by the company except that the angle of actuation has been adapted to conserve frictional area and give strength to the carrier. The clutches have hand adjustment and are proofed against centrifugal force. A setscrew or a set-

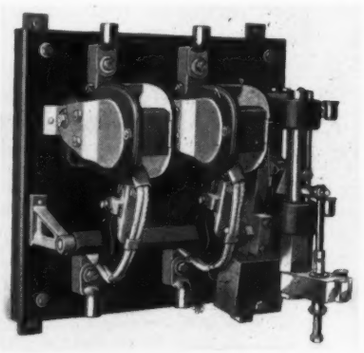


Clutches can be operated either singly or doubly, or for forward or reverse

screw and key are the only means necessary for attaching to the shaft. A tandem plate clutch with adapter cup on which can be mounted a gear or other means of power transmission is shown in the accompanying illustration. Shaft coupling types are also available.

Unit Controls Spot Welders

AN ENTIRELY new system for controlling spot welders, consisting of an air-operated contactor connected directly to the welder head air cylinder, has been designed by Clark Controller Co., 1146 East 152nd street, Cleveland. Being connected in this manner, the unit op-



Welder control eliminates need for a pressure switch or a back pressure relay

erates from the built up or back pressure of the welder cylinder, thereby eliminating the need for a pressure switch or back pressure relay. The contactor cannot close until the welder points have come together on the work which is to be welded, even though no pressure device is used. The design is such that one stroke of the piston both closes and opens the contacts of

the electric welder circuit, and does this accurately. No timing mechanism or timing relay is necessary.

Machine Tool Lubricator Improved

A FULLY automatic centralized system of lubrication for machine tool equipment in a new design is a recent development of Farval Corp., Cleveland. This type "C" unit, shown herewith, of simple and rugged construction, has been simplified to such a degree that it contains only two moving parts. Check valves,

Only two moving parts are contained in new fully automatic centralized system of lubrication for machine tool equipment

stuffing boxes, etc., have been eliminated. Positive, piston displacement type of valves of different capacities are located at the bearings. These valves control the delivery of lubricant to the central pumping unit by means of a single main line of tubing.

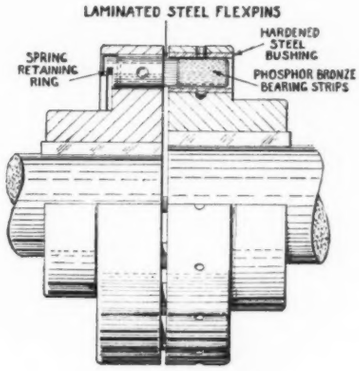
An adjustable timer accurately governs the operation of the system, whether the correct frequency be five minutes or two hours. When desired, the entire system can be arranged to start and stop with the machine to which it is applied.

Flexible Coupling Is Improved

IMPROVED pins which will give increased power capacity and greater protection against shaft misalignments, shocks and vibration are offered in the new Flexpin Couplings of Smith & Serrel, 64A Washington street, Newark, N. J. The new pins consist of a bundle of steel laminations, copper coated to resist rust, and held in a slotted keeper by hardened steel cross pins which are now welded in place. The sliding ends of these pins are longer, have greater area

than formerly, and these ends have thick phosphor bronze bearing strips welded to the outside spring laminations.

The Flexpins are held in place in one flange by a spring retaining ring (or by radial bolts in the larger sizes). Hardened steel bushings, with rectangular broached holes to receive the



Flexible pins in improved coupling are coated to resist rust and are held in a slotted keeper by hardened steel cross pins

ends of the pins, are employed in the other flange and are locked in place. Load pressure between the bronze bearing strips and the sides of the broached bushings is thus separated from the pressure due to centrifugal force as the laminated springs contact with the upper, inside surface of the bushings as well as with the sides of the bushings.

Introduces Industrial Thermometer

SMALL industrial thermometers that can be attached easily to motors, generators and other machines, and which indicate operating temperatures at a glance have been brought out by Ideal Commutator Dresser Co., Sycamore, Ill.

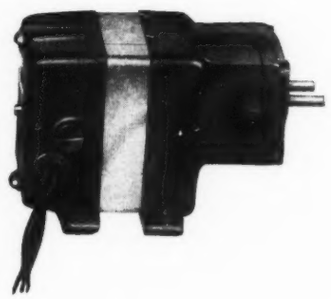
Industrial thermometers can be built into machines to indicate exact temperatures at all times

The instruments, shown herewith, have been developed along bimetallic principles and consist of a dial plate mounted in a dustproof aluminum case, protected by a nonbreakable crystal and chromium plated cap. The dial gives tempera-

ture readings from 0 to 100 degrees Centigrade. The base has a threaded stud that screws into the case, and is attached to the machine frame with escutcheon pins. A flexible rubber ring fits tightly against the machine, keeping drafts and outside temperature fluctuations from effecting the true temperature of the machine be-

Small Motors Are Back Geared

BACK geared motors in a new series of 110 volt, induction and series wound have been added to the line of "Flea Power" motors being manufactured by SpeedWay Mfg. Co., Cicero, Ill. These new motors, shown herewith, which measure less than 3 by 3 by 3½ inches, with built-in speed reducers , differ from the skeleton motors of this line in that they are self-encased with cast steel end bells, and the induction types are air cooled with small rotary blower. The



Built-in gear box on small motors permits innumerable speed combinations for the two shafts

built-in gear box permits innumerable speed combinations for the two shafts, which may have different speeds. The motor has feet to facilitate mounting, either horizontal or vertical. The motors are provided with ample oil reserves for long continuous operation.

Annunciator Units Are Versatile

ANNUNCIATOR units which can be adapted to show changes in pressures, liquid levels, speed, voltage, amperage, temperature, movement of bodies, vibration, flow or any abnormal condition which should receive prompt attention as soon as it occurs on automatically operated machines are now being manufactured by Kellogg Switchboard & Supply Co., Chicago. These annunciators may be operated from photocells and will monitor the operation of other equipment which is photocell controlled. Automatic counters may also be furnished to indicate the number of times that any particular lamp is lighted, thus providing an authentic record of the frequency with which the observed condition occurs within a given period. Also, alarm bells may be made to ring continuously so long as the condition prevails.

Flange Mounting Jumps to Forefront

(*Concluded from Page* 36)

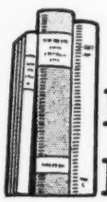
sary. In the Charles G. Allen Co. vertical drilling machine, *Fig.* 4, the motors drive the drilling spindle either direct or through reduction gears. Four-speed motors enable a number of drilling speeds to be obtained with a minimum of gearing and gear changes. In this application it is desirable to keep the motor diameter to a minimum in order that the spindles may be designed for mounting on close centers. In the illustration a spacer is provided between the spindles, but the design of the spindles has been made such that they can be assembled with a minimum center distance of 12 inches for this particular size of machine.

A flange-mounted motor makes practically a direct drive through herringbone gears to the spinning rolls in the Grant rivet spinning machine, *Fig.* 5. The method of connecting this motor to the gears is shown in *Fig.* 6. Male coupling *A* is keyed and pinned to the motor shaft. The motor is then set in motor bracket *B*. Motor coupling *A* sets into female coupling *C* which is also the center spindle. The control part of this spindle also acts as a coupling for the center drive gear *D*. This center gear connects with four, six or eight driven gears *E* whichever number of spindles the job requires. All of these gears run on flange bronze bearings *F* which is also the bearing for the driven gear spindle *G*. The spindle *G* projects, allowing room to connect the universal joint which in turn connects with roll holder spindles.

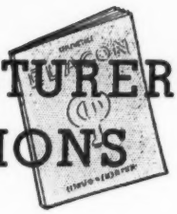
Varied Motors Employed

Several interesting motor applications are shown in the billeteer of *Fig.* 7. The carriage is driven preferably by a two-speed motor especially designed for quick and frequent starting and stopping. The high speed is used for movement of the carriage in the return direction and the low speed is used for movement in the forward, or cutting, direction. The motor, at *A*, is of the built-in type, with special ring mounting on the end of the machine. The tool head is raised and lowered by means of a vertical gearmotor at *B* built into the top of the carriage.

For their considerate co-operation in the preparation of this article, and for the illustrations used, MACHINE DESIGN wishes to thank: Louis Allis Co., Electric Specialty Co., Emerson Electric Mfg. Co., General Electric Co., Holtzer-Cabot Electric Co., Howell Electric Motors Co., Reliance Electric & Engineering Co., and Westinghouse Electric & Mfg. Co.



MANUFACTURERS' PUBLICATIONS



ALLOYS (HARD-FACING)—How to make a part wear longer by hard facing and overlaying is given in a 16-page bulletin of Lincoln Electric Co., Cleveland. The publication details the conditions which cause the breaking down of metallic working surfaces, where hard facing by arc welding can be used to advantage, how to choose the proper electrode, and notes on the use of the various electrodes.

BEARINGS—The lubrication of bearings in electrical machinery is the subject of a catalog insert prepared by Imperial Electric Co., Akron, O. The sheet gives the care of ball bearings, ten ball bearing commandments and pointers on sleeve bearings.

BEARINGS—Oilless bearings, intended for application where the use of oil or grease is objectionable or impractical, are covered in a folder of Spadone Machine Co., New York. Complete details on the bearings are given.

BEARINGS—Load ratings and diagrams of mountings for ball and roller bearing pillow blocks, flanged housing, take-up boxes, post and drop hangers, floor stands, replace boxes, locknuts and lockwashers are given in a 32-page catalog of SKF Industries Inc., Philadelphia. Data to aid selection are included.

CLUTCHES—A newly designed general purpose magnetic clutch is presented in bulletin 522 of Cutler-Hammer Inc., Milwaukee. A feature of the new clutch is the method of adjusting the friction faces to compensate for wear and to assure uniform lining engagement.

CONTROLS (ELECTRICAL)—Automatic motor starters of the across-the-line type in all frequencies are featured in a folder of Lincoln Electric Co., Cleveland. Design of the controls makes accidental starting impossible.

COUPLINGS—A folder on flexible couplings, gear type and cross type couplings, and silent steel gears is being distributed by John Waldron Corp., New Brunswick, N. J.

COUPLINGS—Improved Flexpin couplings which have pins consisting of a bundle of steel laminations, copper coated to resist rust and held in a slotted keeper by hardened steel cross pins which are now welded in place are described in bulletin No. 49 of Smith & Serrell, Newark, N. J.

DRIVES—Reeves Pulley Co., Columbus, Ind., is distributing a folder which gives details on the construction and operation of the company's new automatic hydraulic control for controlling infinitely variable speed drives.

DRIVES—Medart Co., St. Louis, has assembled in a

144-page catalog complete information on its line of power transmission equipment including bearings, clutches, couplings, sheaves, pulleys, rope drives, V-belt drives, shafting, pillow blocks, hangers and other equipment manufactured by the company.

DRIVES—Vickers Inc., Detroit, is distributing a new bulletin, 35-8, on its variable speed transmission. Details of the construction and operation of this hydraulic transmission are presented. The unit gives infinitely variable speed with accurate control.

DRIVES—Gearmotors in eight types for various horizontal and vertical arrangements are shown in leaflet 2203 of Allis-Chalmers Mfg. Co., Milwaukee. The units can be furnished with any type of alternating or direct current motor by adapting the construction of the gear end to suit the mechanical design of the motor.

INSTRUMENTS—How to obtain precision control of temperature, pressure, rate of flow or liquid level on continuous processes which involve time lags and load changes is given in bulletin 37R of Taylor Instrument Cos., Rochester, N. Y.

INSTRUMENTS—Industrial thermometers, miscellaneous metal and woodback thermometers, hygrometers, U gages, mercurial vacuum gages and mercurial barometers are included in catalog No. 1125 of C. J. Tagliabue Mfg. Co., Brooklyn, N. Y.

INSTRUMENTS—Ideal Commutator Dresser Co., Sycamore, Ill., has issued a folder on its small industrial thermometer for determination of temperature in both open and closed motors, bearings, air compressors, centrifugal pumps, etc. The instrument can be permanently attached to the machine.

INSULATING MATERIALS—Johns-Manville, New York, has just published booklet No. IN-7A, "Barriers to Industrial Waste," describing and illustrating insulating products for every temperature from 400 degrees below zero to 2500 degrees Fahr. A table of recommendations is included.

LUBRICATION AND LUBRICATING EQUIPMENT—Rivett Lathe & Grinder Inc., Brighton, Mass., is distributing an attractive bulletin, B-10, on the Blanchard Pulsolator system of automatic oil lubrication for industrial machinery. The valves in the pulsolator feeders open in response to each pulsation in the system. No small fixed openings or felt barriers which require replacement are employed.

MOTORS—Back geared "Flea Powered" motors are presented in a leaflet prepared by Speedway Mfg. Co., Cicero, Ill.

PUMPS—Waukesha Foundry Co., Waukesha, Wis., has prepared bulletin 505 which gives complete information on the company's line of pumps, a positive displacement type of pump which operates at slow speeds. Included in the bulletin are charts showing the RPM necessary for required delivery against various head pressures.

SHAPES—Rolled steel for machine construction, details on the materials available, how the steels give a freedom

of design, and how they give eye appeal to the machine are considered in an attractive booklet prepared by Illinois Steel Co., Chicago, and Carnegie Steel Co., Pittsburgh. The comprehensive booklet includes a number of photographs showing what has been done with rolled steel in the design of many types of machines.

TUBING—Complete information on welded and seamless mechanical tubing for use on a wide variety of machines is included in List No. 3 of National Tube Co., Pittsburgh. The booklet includes a general description, data on alloy tubing, and dimensional and physical data on the tubing in the line.

WELDED PARTS AND EQUIPMENT—Hobart Bros., Troy, O., has prepared a new bulletin on its new 75 ampere arc welder.

WELDED PARTS AND EQUIPMENT—Vertical, direct current arc welders in a new design are described in a recent folder of J. D. Adams Co., Indianapolis. In the design the exciter has been eliminated, thus reducing the tendency to accidental reversal of polarity.

Research Publications

The Relation Between Axial Length Changes and Rockwell Hardness of Carbon Steels, by H. E. Publow and Lyle Clark. Many factors influence the ability of a steel to return to its original shape after being subjected to a proc ess of heating and cooling. Among these may be mentioned the heating and cooling rates, the maximum temperature attained by the steel, and the state of equilibrium of the metal. The authors go thoroughly into these factors, and present photomicrographs and charts which completely cover the development. Presented as bulletin No. 62 by Michigan Engineering Experiment Station, Michigan State college, East Lansing, Mich. 19 pp. 25 cents.

A Simple Method for Bearing Design, by E. M. Staples. Whenever a moving and a stationary part are in contact there is, necessarily, friction. The extent of this friction is dependent either on the nature of the rubbing surfaces or on the efficiency of the methods of lubrication. As the friction incurred when two solid objects are rubbed together is considerably greater than the friction between the molecular components of a fluid, solid friction is to be avoided and fluid friction becomes necessary for the efficient transmission of motion. The importance of lubrication, the substitution of fluid or partial fluid friction for solid friction, cannot be overestimated. It is important not only from the standpoint of reduced friction, but is equally important in preventing damage to adjacent parts. As bearing wear, and failures due to wear, most often occur under conditions of inadequate lubrication, it is essential that lubrication be given first consideration in bearing design and that the choice of bearing metal be made subsequent to the design. Published by Aluminum Industries Inc., Cincinnati. 55 pp.

Controls Should Be Built In—Not Hung on!

(*Concluded from Page* 53)

tection. This feature not only prevents inadvertent starting on the return of power, but also gives quick and positive stopping of the platen if the voltage fails. In some older type planer drives dynamic braking was not effective when voltage failed. This control system provides a self-excited dynamic braking circuit that will cause the platen to stop faster on emergency braking than in normal operation.

Use of stroke limit switches for automatic control of the reciprocation of the platen makes it possible to operate this part at speeds in excess of 300 feet per minute. The operator's control station is arranged for separate mounting. Thus it may be situated at a location convenient to the operator while the main control panels are installed at a remote location where floor space is not so valuable. This arrangement makes it possible to mount the control panels on a gallery, a method of installation that is growing more popular. Solenoids are built into the swivel pins on each head to operate the magnetic tool lifters. The solenoid keeps the tool holder up during the return stroke and is de-energized at the end of the stroke, allowing the tool holder to fall into the cutting position for the next cutting stroke.

Designer Best Qualified to Judge

To return to the designer's part in selecting controls, the builders of electrical devices are recognizing the fact that he is more familiar than ane one else with the particular characteristics and requirements of his machine. Consequently he is best qualified to determine the type of control necessary. If a machine tool builder, for instance, allows his customers to furnish their own controllers, some are almost certain to use incorrect equipment, which in such cases reverts unsatisfactorily back to the manufacturer. Even when correct equipment is chosen there is a possibility poor location and poor wiring will result. Therefore, to obviate all opportunity for this to occur the designer will be wise in employing built-in controls that are installed before the machine leaves the shop.

For their part in the compilation of this article MACHINE DESIGN wishes to thank Allen-Bradley Co., Milwaukee; Cutler-Hammer Inc., Milwaukee; General Electric Co., Schenectady; N. Y.; Ingersoll Milling Machine Co., Rockford, Ill.; Monarch Machine Tool Co., Sidney, O.; Pratt & Whitney Co., Hartford, Conn.; Wm. Sellers & Co. Inc., Philadelphia; Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

INDEX TO ADVERTISERS

*Advertisements appear in previous issues.

CROSS SECTIONS

MANY an exposition has been censured for a cost disproportionate to the value received, but from advance dope the Machine Tool Show won't receive this criticism. Several machine builders we have contacted are looking forward to this show as a "selling show," and that in the face of the excellent recent rise in the machine tool index. Machine tool builders may receive orders, but engineers attending the show will also receive, and the commodity they will receive is information on the most progressive design and production ideas ever available.

MANY a designer has been handicapped in making a new design by trying to make the new one look like the old. When you are working on a completely new development, or with a new material, throw away your previous conceptions. The best way to make a new design is to start all over; old ideas obtained when working with one material, may be too big a handicap for the new material to overcome.

USE OF plastics has grown enormously in machines during the past few months, and possible size has grown also. The latest and biggest is the new Toledo scale which has a housing large enough to accommodate a good many parts as used on many another machine. Its stainless white would be of advantage to household and baking machinery builders.

TUNGSTEN carbide is such a fine material for cutting tools that the fact that it isn't used almost universally aroused our curiosity. We had a hunch as to the reason, and perhaps you may wish to know the answer the machine tool builders give us. The material is so expensive that it is not practical from a cost standpoint to equip all machines with these tools. Perhaps if the price were brought down, more universal use would pay for the reduction.

WE WISH you could all come along with us on our swings around the country and see the outstanding design developments soon to be presented. We'll give you a hint of one trend. Hydraulics, after kicking around a hundred design departments for far too long, is emerging not as a tentative plan, but as a full-fledged development. In addition to the commercial units now available, there will soon be more. And, too, dozens of machine builders are coming out with their own ideas of hydraulic operation.

A QUESTION you might discuss with your engineer friends over something tall and cool is—Will the design of tomorrow in production machines be almost 100 per cent special? Signs seem to point in this direction. Take note of the many units which are being built into machines which then become entirely special machines, and the units which can be taken apart to form still different machines. In every case a standard "line of machines" seems to be forgotten.

DESIGNER'S hobbies, mentioned in August, have proved to be interesting and varied. One chief engineer showed us photographs taken in his home that would do credit to a professional photographer. A mechanical engineer sends us a fine suggestion. He is a scoutmaster in his spare time and believes that scouting is one of the best things for engineers and that engineers are the best men for scouting. Another concentrates on relief work, while postage stamps take the spare moments of several whose daytime hours are concerned with mechanisms. What's your hobby?

WHO is going to be first to feature photoelectric control of travel on machine tools? If we don't see this development at the machine tool show, watch for it within the next few months.

Business and Sales Briefs

FRANK L. GIBBONS has been elected vice president in charge of sales for Timken Steel & Tube Co., Canton, O. Mr. Gibbons has been director of sales since 1932 and has been associated in a sales capacity with Crucible Steel Co., Central Steel Co., Central Alloy Co., and Republic Steel Corp.

• • •

Western Washer & Mfg. Co., Los Angeles sales agents for Wrought Washer Mfg. Co., Milwaukee, has moved to 2111 East Fifty-first street. A larger and more varied stock of washers will be carried.

• • •

The San Francisco district sales office, factory and warehouse of Garlock Packing Co. will be located in the Garlock building, 930 Bryant street, San Francisco after November 1.

• • •

S. Howard Eisenberg has been appointed sales engineer and representative in Colorado, Utah, Wyoming and western Nebraska for Foote Gear Works Inc., Cicero, Ill. His headquarters will be at 1367 Marion street, Denver.

• • •

Taunton-New Bedford division of Revere Copper & Brass Inc. have been removed to New Bedford, Mass., where the company's principal New England mill is located. Mill operations and a warehouse will be continued in Taunton.

• • •

Air Reduction Sales Co., New York, has established company-operated stores at 336 Spring street N. W., Atlanta, and 18-20 North Cheyenne avenue, Tulsa. The Portland, Oreg., store has been moved to 13 Northwest Fourth avenue.

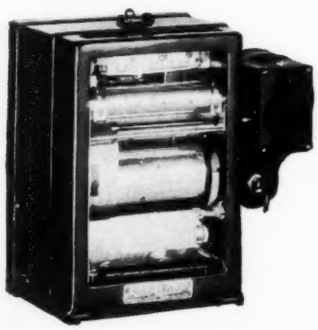
• • •

Trabon Engineering Corp., manufacturer of lubricating equipment, has moved its manufacturing plant to East Fortieth street at Kelly avenue, Cleveland. William A. Chapman is now representing the company in the Pittsburgh district. Louis H. Hein Inc., Philadelphia is in charge of the company's Atlantic coast business aside from greater New York which will be handled by Fink, Dumont & White, New York city. The F. J. Johnson Co., Cleveland, represents the company in Ohio and the Chicago districts, while the Michigan territory is handled by J. N. Fauver Co.

ENDURANCE

A large manufacturer using "ENDURANCE" as the governing qualification of the motor for his appliance, made a survey of motor repair shops. After obtaining first hand the information regarding frequency of repairs required for various makes of motors, he adopted EMERSON Motors, commenting: *"After the survey our choice was simple. Why, service men even went so far as to say they seldom saw Emerson motors—they require so little attention."*

There are EMERSON Motors now in use that have given continuous satisfactory service for over 36 years. But amazing as these actual service records are, the motors produced by Emerson today have a still longer life expectancy! The reason is simple. Tests are constantly conducted, under every conceivable operating condition, to determine the life span of the various parts that make up a motor. These tests have resulted in a reduction of motor wear—in unfailing, trouble-free service—in longer life. Write today for Bulletin 11M—"Tests, Hundreds of Tests."



Emerson Helps Esterline-Angus Guard "Hot Wires"

Esterline-Angus selected Emerson Motors to drive the charts in their high speed recording instruments, after the most exacting tests. These instruments record the disturbances which occur on high voltage power lines. The motors run *continuously* and the meters go into operation in 1/30th of a second after the disturbance starts.

The Esterline-Angus Company, known the world over for dependable and reliable recording instruments, looked for a motor as dependable as their meter—they adopted Emerson ten years ago and have used them ever since.

FANS EMERSON MOTORS BUILT TO LAST

EMERSON MOTORS

3 HP and smaller—Single-phase—Polyphase—Direct Current

THE EMERSON ELECTRIC MFG. CO.

NEW YORK ST. LOUIS CHICAGO

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